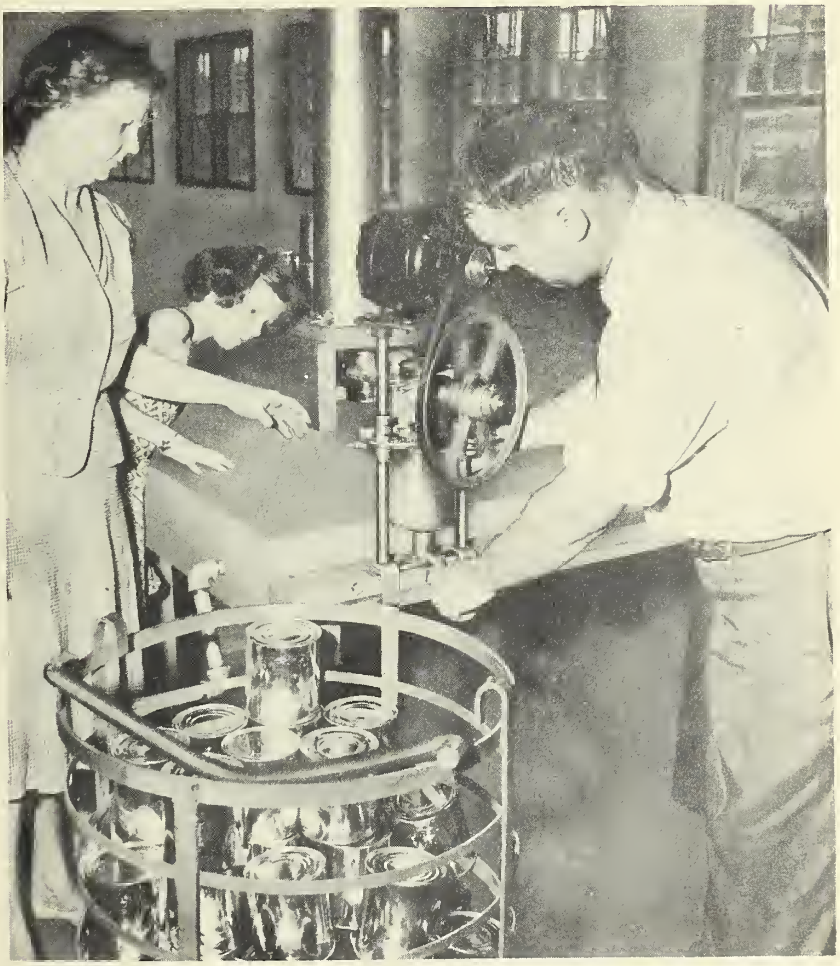
Community CANNING CENTERS



Miscellaneous Publication No. 544

Production and Marketing Administration
UNITED STATES DEPARTMENT OF AGRICULTURE

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Preface

Community canning centers have found a definite place in the life of many communities. That they fill a need is shown by the fact that there has been a continual increase in their number and an expansion of the facilities of those already established. These centers serve many useful purposes. They prevent waste of locally abundant foods and improve the nutritional level of lower income groups by preserving home-grown foods for use at a time when fresh produce is relatively high in price. Schools have found that by using these centers to can produce for their school-lunch programs they have been able to provide better lunches without increasing their cost to the children.

As a result of the development of interest in community canning centers many requests for information on their establishment and operation have been received. This publication, a revision of Miscellaneous Publication No. 544, is intended to provide answers to these requests. The information contained in the April 1944 issue of Miscellaneous Publication No. 544 and the supplements released in August and September 1944 have been incorporated in this edition with slight revisions. In response to numerous demands, a section has been added on the establishment and operation of small canning centers that use gas burners.

The instructions given are based on experience acquired in the organization and operation of successful food-preservation centers and on information obtained from authorities in the field of canning. The canning techniques presented are for approved steam-pressure and water-bath methods and are based on ungraded products packed in a clean, sanitary manner. Since it was necessary to prepare this material for use on a national basis it may be found that the techniques here recommended need slight modification in some cases in order to conform with State laws on food, safety, health, and sanitation.

Although the scope of this publication has been limited to canning, many communities have found it desirable to provide facilities for other methods of preservation, such as quick freezing, dehydrating, salting, and brining. Much of the equipment used for the preparation of foods for canning may be used for the preparation of foods to be preserved by any of these methods, thus effecting a saving in space and cost of equipment.

Washington, D. C.

Issued April 1944
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Community Canning Centers

Prepared by the Production and Marketing Administration, United States Department of Agriculture

Getting the community organized

Community canning centers will not just happen. They must be planned and arranged for well in advance of the season in which they are needed. Planning soundly and getting the center operating on a business basis from the beginning are necessary if the center is to be successful over a period that justifies the expenditure of money and effort involved.

Successful canning centers usually are the result of group action spurred on by some individual who sees the need for providing facilities for preserving food and has the energy to do something about it. It doesn't matter who this is—an energetic homemaker, a home demonstration agent, a businessman growing his first garden, a teacher of vocational agriculture or home economics, or a civic leader.

Such a leader will round up a group of interested persons to determine the need, the interest, the territory to be served by the prospective center, whether all families or only a limited number in the territory are to be included among patrons of the center, and what canning equipment is already on hand in the community. Many communities include school lunch and institutional needs in the initial survey, as such a tie-in is desirable in affording permanency to the program.

A satisfactory method of getting much of the information needed in the survey is to send circulars or questionnaires to families in the community. Such questionnaires will determine whether or not a family is interested, the kind and amount of food they would like to put up, and whether this food will be home-produced or bought. A more accurate survey can be had if food budgets recommended by State departments of agriculture are used as guides for setting up information to accompany the questionnaires.

Where the initial survey reflects a real need and interest in establishing a canning center, the most effective way of getting the matter in the hands of community members is to have a public meeting. At this meeting a working committee should be elected and given the authority to get the program organized and operating. This committee will then need to report only occasionally to the whole group of persons participating in the program.

On the personnel of this committee will depend the effectiveness of the program. Its membership should include representative citizens who can head subcommittees to handle specific problems involved, thus building up an effective organization. It is well to include on the committee a businessman, a home economist, a teacher of vocational agriculture, an engineer, a newspaper publisher, a health officer or physician, members of civic and service clubs, school boards, and local government. Subcommittees may need to be organized to give direction and supervision on (1) financing, (2) housing and equipment, (3) public relations and arbitration, (4) operation, and (5) health and sanitation of the plant. By dividing the direction of the program in this way the responsibility is left to a group rather than to an individual.

Until the plant has been established and is ready to operate, the working committee will be busy making such decisions as the following: (1) How to finance the cost of the center, (2) selection of a supervisor or manager, (3) size and type of preserving units to be installed, (4) selection of site and building, (5) development of floor plans for installation of equipment, (6) purchase and installation of equipment and supplies.

With the supervisor, the working committee will determine what the policies of the plant will be on agreements to be made with patrons, the type of training that patrons will be given, the number of persons required to operate the plant, and the means of informing the public of the plant's progress. As the season gets under way, the supervisor will need the assistance of the committee to solve operating problems and to make improvements or changes in the canning center from time to time.

Plan for financing

A community cannery must have initial funds for equipment and supplies, housing and utilities, necessary labor and supervision, and for protective insurance for workers. Such funds may be obtained through popular subscription or a bond issue in the community. Often, however, the local board of commissioners, welfare board, school board, farmers' cooperatives, chamber of commerce, or civic and fraternal organizations assume these initial costs. Many communities have found it advisable to incorporate the canning center on a nonprofit basis.

In some States, legislatures have appropriated funds to assist in establishing and operating food-preservation centers. Other sources of support for the community cannery are contributions by civic-minded

individuals or groups. Committees should investigate all possibilities for financial assistance. They will get helpful information on available Government aid from the State agricultural extension service or the State department for vocational education.

To pay the overhead costs of the center, the usual method is to collect a small service charge for each can of food processed. This cost is based on the price of the can, plus a small charge for services and utilities. If the plant is operated at capacity, a fund may accrue from this source to pay off indebtedness as well as to cover costs of replacements and repairs. Capacity production is more readily assured in those canneries extending their facilities to school-lunch programs, institutions, and welfare needs, as well as to families in the community. Sometimes a toll in canned products is collected from patrons as part of the service charge; such products being donated to school-lunch and other tax-supported programs.

If the committee maintains central control of purchases for the seasonal supply of cans and fuel, a real saving in overhead costs can be realized. Containers may be purchased in cooperation with other communities if the quantities required do not make up a carload lot. (See Purchase of Cans, p. 38.)

Selecting a supervisor

Every canning center should have, if possible, a paid supervisor who is on the job all the time that the center is in operation. In large canning centers such a supervisor is essential.

The supervisor will have the responsibility of seeing that patrons, employees, and volunteer workers are well trained in proper methods of preparing and processing foods and in operating the equipment. She will be responsible for making appointments, scheduling produce, scheduling and supervising employees, determining and ordering supplies needed, and maintaining the necessary records for efficient operation. She will also assume responsibility for the care, replacement, and repair of equipment.

From time to time, she may present to the committee plans for improved operation, such as rearrangement of equipment for a better flow of work, or for additional equipment required to improve or expand operation.

Qualified supervisors are likely to be found among home demonstration agents, teachers of home economics or vocational agriculture, commercial canners, and canners trained in the former WPA program. If possible, it is well for the supervisor to have had actual experience in operating a canning center. In addition to being able to direct and train others, the supervisor should possess good judgment and ability to meet emergencies.

State training courses, conducted by groups or agencies directing or assisting community food-preservation programs, should be attended by the supervisor selected. Other training experiences, such as visiting a commercial cannery, may prove helpful in planning and scheduling work and evaluating the plant in terms of improved efficiency.

Where a State agency provides the services of a State-wide technical supervisor and a bacteriologist, communities should request their assistance as necessary.

Deciding on the size and type of cannery

The size of the cannery will be determined by the quantity of produce that will need to be canned daily to meet the total anticipated production requirements for the canning season.

To estimate roughly what the daily capacity of the unit should be, divide the estimated total number of cans to be processed during the season by the approximate number of days the cannery will operate. The canning season will vary with the length of the harvesting season and the kinds of produce to be canned. Add from 10 to 15 percent of the quotient obtained to allow for the peak production period when the greatest variety and amount of food can be expected. Whenever possible, a year-round plan of operation is advisable and should be encouraged. This is particularly important in areas in which farm animals are slaughtered and canned.

The small center, using pressure canners and small retorts heated by gas burners, is satisfactory for a daily production up to 800 cans of produce. (See Small Canning Centers Operated with Gas Burners, p. 39.)

The steam-operated plant, using small and medium-sized retorts, should be established where the expected daily production is greater than 800 cans. (See Steam-Operated Canning Centers, p. 7.)

In some rural areas canneries are of a size to accommodate patrons on a county-wide basis. In other instances it is advisable to establish several plants within a county. This is particularly true where urban families are interested in participating in canning activities or where transportation difficulties do not make the county-wide plan feasible.

Selecting the site and building

The site for a community cannery should be considered first of all in the light of a central location for the area to be served. Other factors to be considered are existing regulations regarding the establishment of such a plant in the area, the water supply and other utilities, the availability of parking space, and the avoidance of congested traffic. Where facilities are to be made available for processing foods for school-lunch programs, institutions, and welfare groups, consideration will need to be given to the location of the plant in relation to trucking routes and railroads. This would particularly apply to those plants planning to take advantage of the abundant foods made available through Government purchase programs.

Figure 1.—Community canning plant, Frisco City, Ala.

Running water is a minimum requirement because of the varied needs for safe and efficient operation. The water supply line should be of adequate size to deliver an ample supply for all processing and sanitation needs. In the absence of a previously approved water supply, the water should be tested for mineral content, purity, and degree of hardness.

Electric service should be heavy enough to support the load required and should be of the voltage necessary to operate the motor-driven equipment.

Gas service for gas-operated units should be adequate for operating all units in the plant at the same time.

A telephone should be provided to facilitate scheduling. In large plants an extension may be necessary.

The building most practical to house a community cannery is one in which the equipment can be located on the ground floor. The size of the building should be determined by the amount of produce to be canned and the type and amount of equipment to be used. A rectangular building is most desirable because its floor space can be used to best advantage when arranging equipment. (See fig. 1.) However, any space having the required number of square feet could be used. While it is desirable to construct a new building specifically designed for this purpose, used buildings that can readily be converted are satisfactory. Suitable buildings for steam-operated canneries include abandoned bottling works, bakeries, laundries, garages, creameries, and other buildings where steam facilities have already been installed. Buildings adjacent to steam facilities may also be used. Check such facilities to make sure that they are of ample capacity to supply both plants. Pressure-canner units may be located in schools, church basements, or similar places that provide needed space and utilities.

The building needs to be well lighted and properly ventilated. Sufficient windows should be provided so that artificial lighting will not be necessary during the daylight hours. However, artificial lighting will be required at times and should be planned for and so arranged that each operation will be well lighted. Lights should be suspended above head level and so shaded as to prevent glare.

Windows arranged to take advantage of the prevailing winds will provide good cross ventilation. In one-story buildings the ventilation and lighting may be improved by the use of roof ventilators and skylights. It may be necessary to supplement natural ventilation with exhaust and circulating fans.

Be sure the ceiling is high enough to assure a comfortable room temperature. A minimum ceiling height of 10 feet is required to allow for clearances necessary where a track and hoist are used over retorts. The floor-load capacity of the building should be determined and should not in any case be exceeded. In Northern States consideration must be given to heating the building during the winter season if the plant is to be in use at that time.

Floors should be constructed of rough-finished concrete, free from cracks and crevices, and should be well drained at or near the points where quantities of water are used. Drain locations should be predetermined in relationship to the installation of the equipment. For proper floor drainage the pitch

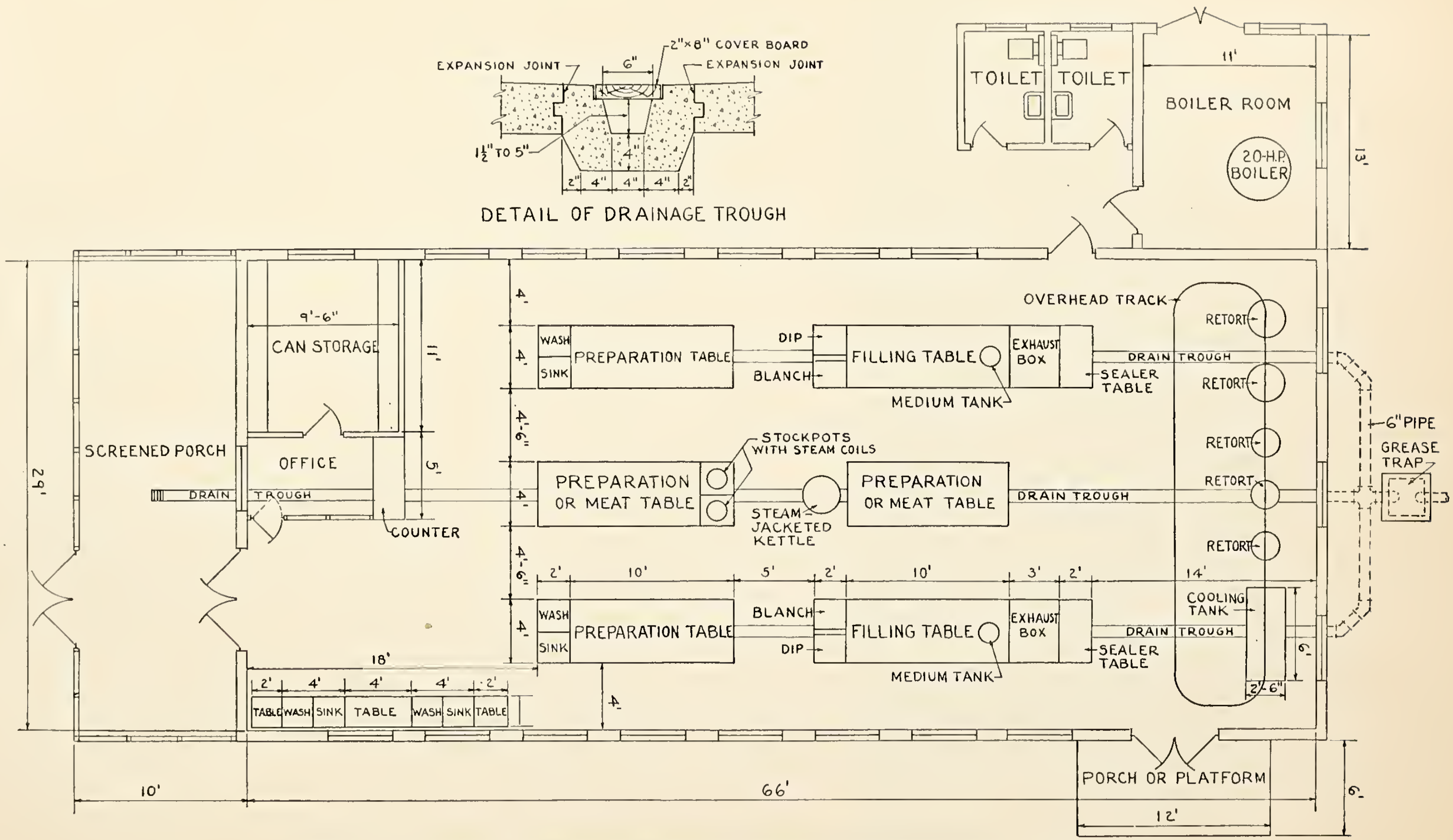

Figure 2.—Floor plan of community canning plant with daily capacity of 2,000 to 3,000 No. 3 cans.

from the wall to the drain should be from ¾ to 1 inch for every 10 linear feet. Box gutter drains are most suitable in that they are readily accessible for cleaning. The drain should be connected with an adequate sewage disposal system. In some cases it may be necessary to install a septic tank.

The walls should be in good repair and have a surface that can easily be kept clean.

The building should have at least two doors. A double door should be provided at the most convenient point for delivering produce to the plant. A single door should be provided for checking out canned goods. It is preferable that doors open outward and that all openings of the building be well screened.

Making the floor plans

The floor plans shown in this publication illustrate the placement of equipment to insure a good flow of work through the plant. They should be carefully studied and adapted to suit best the needs of the community.

Figure 2 is typical of an average-sized steam unit and includes the important details that will need to be considered when making a floor plan for this type of plant.

Figures 3 and 4 illustrate a combination steam and gas-burner unit. This combined service permits the processing of small quantities of produce during slack seasons, thus eliminating the need for operating the boiler during such periods. A floor plan for a community canning plant in which gas burners are used as the sole source of heat is shown in figure 56, page 39.

Several possible floor plans will need to be made showing in detail the placement of all equipment and the continuity of expected operations. Since the sequence of operations varies somewhat with different products, the floor plans drawn up should be checked to determine which ones would best accommodate the kinds of produce to be canned. An effective way to develop floor plans is to place cut-to-scale cardboard models of the equipment on the scaled floor plan of the building.

In determining the placement of equipment to permit a steady progressive flow of produce through the plant consider first the receiving area. This area may be inside the plant or outside on a screened porch or platform. This area will necessarily vary in size with the anticipated capacity of the plant. For convenience in checking in produce, the area should be provided with a small desk or table for the receiving clerk. The receiving area should be large enough to include a table for rough preparation of produce, such as husking corn or topping vegetables, and also for the rough washing of greens or the soaking of root crops. This area is often used also for the temporary storage of produce that cannot be handled promptly. Space so used should be as close as possible to the line of production to avoid interference with traffic or plant operations.

In planning the preparation area, sufficient space must be provided for patrons to wash the produce and prepare it for processing. Careful consideration should be given to the placement of equipment so that the maximum use can be made of it and patrons will not interfere with each other in getting the work done. For example, the placement of the wash sinks and the blanch and cold-dip tanks should be considered in relation to the preparation and fill tables, and the exhaust box and sealer must be conveniently located near the fill table. Storage for pans, trays, hand tools, and supplies should be provided as near the preparation table as possible.

The processing area should be concentrated in a part of the building removed from the working areas where produce is received and prepared. In steam-operated plants, retorts will need to be placed as near as possible to the area where the boiler is housed for efficient use of steam and economy of installation. Where a cooling tank is provided, it should be placed between the processing equipment and the checking-out area. This assures the continuity of operations necessary for rapid handling of the canned produce and avoids congestion in this area. Furthermore, in steam-operated units it is thus possible to extend the track and hoist over it to facilitate the transfer of the baskets from the retorts to the cooling tank.

It is best to have the checking-out area at the opposite end of the building from the receiving area. However, in some canneries it may be necessary to do the checking out in the same area as that in which the produce is received. This is particularly true in small canneries where one person is responsible for both jobs. Where it is necessary to use the receiving area to check out the products a definite plan will need to be worked out for routing the canned products through the cannery so as not to interfere with receiving, preparation, and processing activities. Unless facilities are provided near the cooling tank for the sorting of patrons' cans, tables and shelves for this purpose should be provided in the checking-out area.

When making floor plans, provision must also be made for the storage of empty cans. This space may be provided within the building or in some convenient location nearby. If the can storage space is provided in the building, it should be separated from the rest of the cannery by a partition to keep the area free from steam, which causes the cans to rust. In the larger steam units it is also desirable to provide separate office space. In addition there should be separate dressing rooms and toilet and lavatory facilities for men and women, properly segregated from the canning area. Hand-washing facilities should also be provided within the cannery. In steam-operated units, a room adjacent to the cannery will need to be provided for the boiler. For safety reasons the entrance to the boiler room should be outside the cannery proper. The final determination of the floor plan and the arrangement of the equipment should be checked, if possible, by a person who has a thorough knowledge of the sequence of operations and the use of the equipment.

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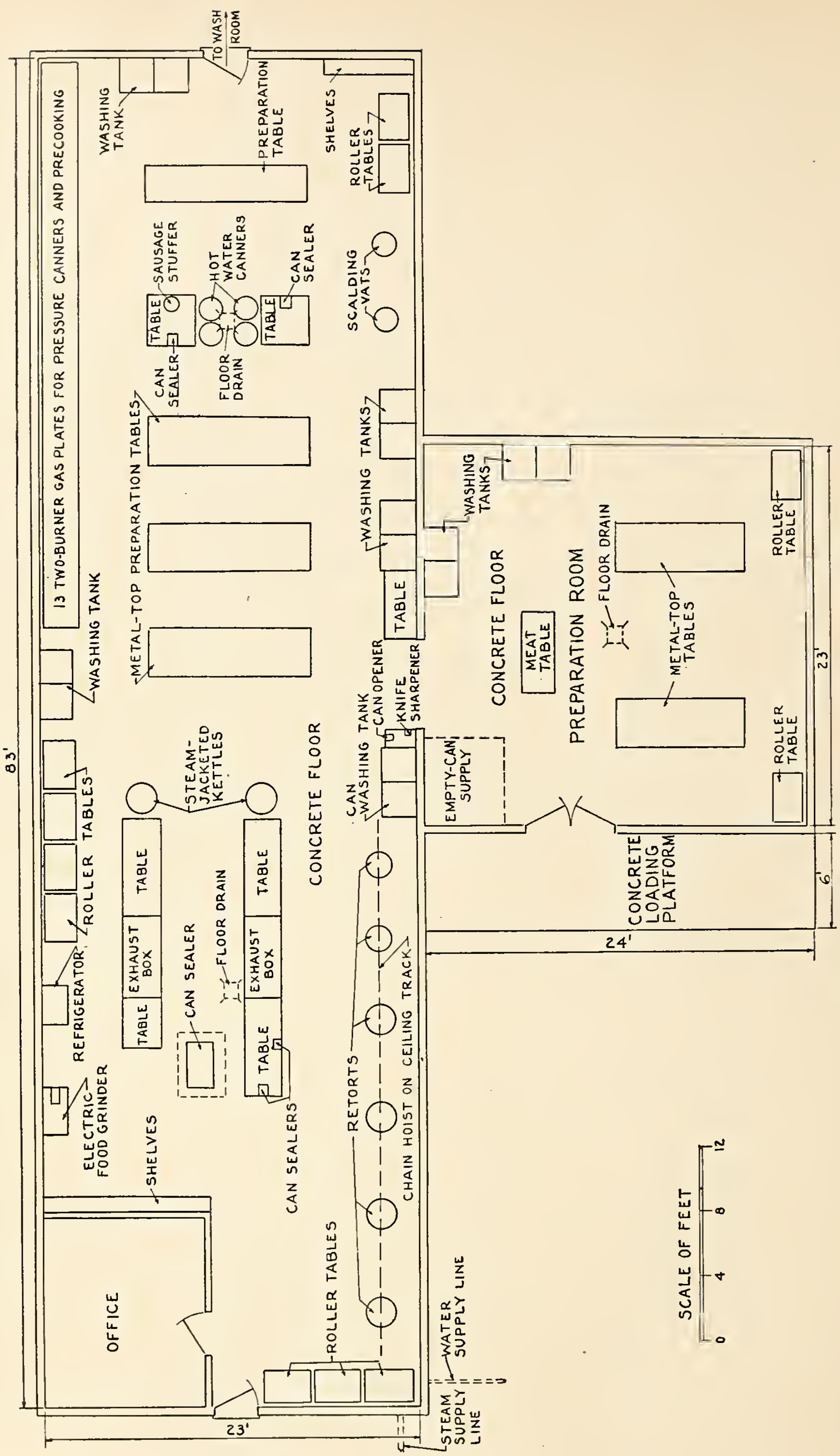

Figure 3.—Floor plan of community canning plant, Jacksonville, Fla.

Steam-operated canning centers

Community canning plants can be operated most efficiently if steam is supplied from a central source as this permits all operations requiring steam to be carried on simultaneously. This factor is important if continuous and maximum production is to be realized.

Equipment required for a steam-operated plant similar to that illustrated in figure 2 is listed in table 1. Since equipment from different manufacturers varies, it is extremely important to study canners' supply catalogs before placing orders. The information given in this publication regarding each item of equipment should also be studied.

Boilers

A fire-tube high-pressure boiler is considered most satisfactory for cannery use as this type of boiler has the fastest recovery when sudden demands are made for steam. It may be of either vertical or horizontal design and can be fired with coal, gas, or oil. Figure 5 shows a vertical coal-fired boiler, the type most commonly used in community canneries.

Boilers specially designed for the fuel used will give better performance than reconverted ones. It is recommended that only those boilers be purchased which meet the specifications of the American Society of Mechanical Engineers' Boiler Construction Code. If second-hand boilers are used they also should have been built originally in accordance with this code and, before being put into service, should be tested for 30 minutes by a competent inspector and should successfully stand a hydrostatic test of double the pressure at which they are to operate. During this test period the hammer test should be applied. Boilers in community canneries will vary in size from 15 to 35 horsepower, depending on the anticipated daily output of canned food and the steam-operated equipment required to process it.

A 15-horsepower boiler is the minimum-sized boiler recommended for any community cannery operated

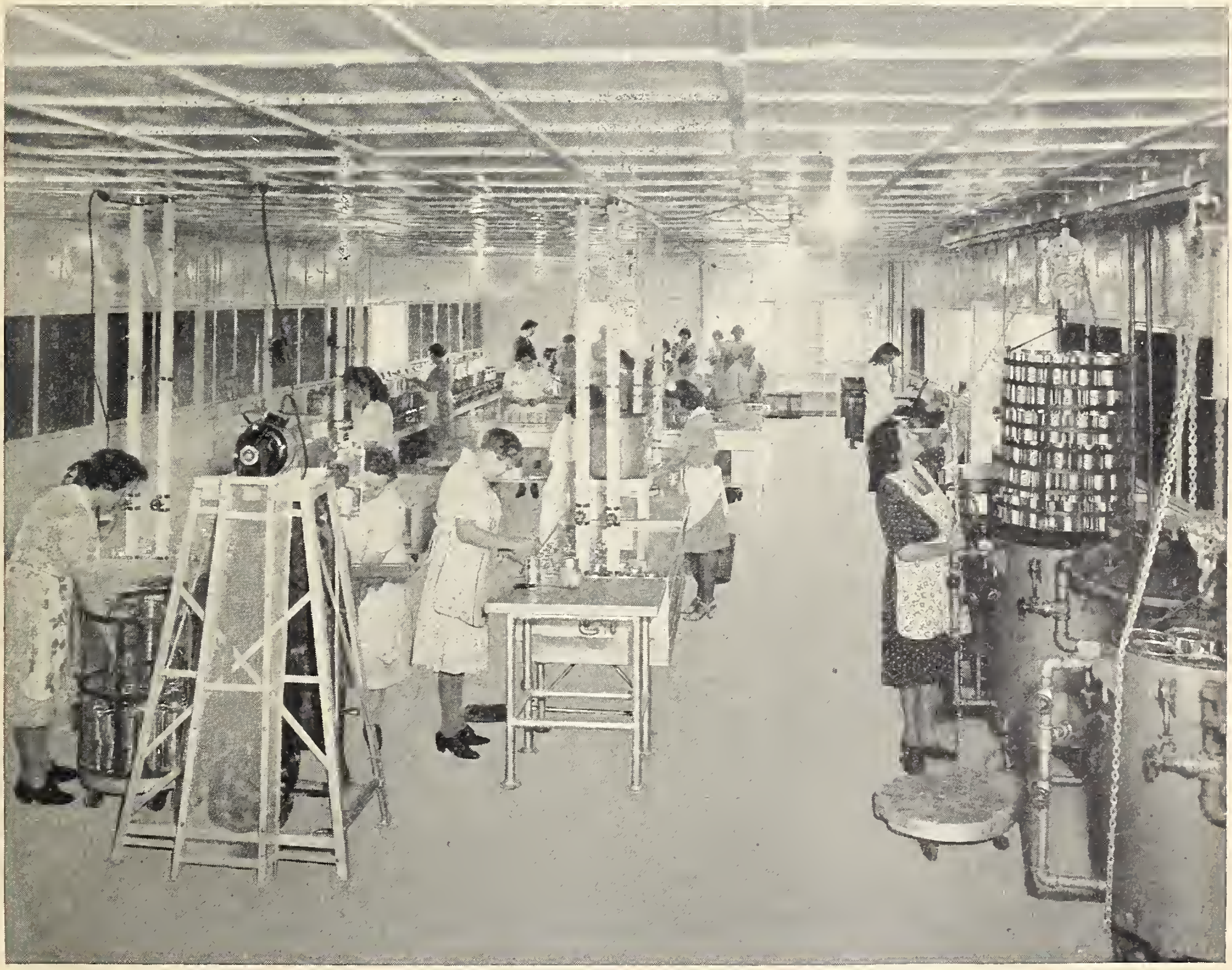

Figure 4.—Interior of main part of community canning plant, Jacksonville, Fla.

Table 1.—*Canning equipment required for steam plant of 2,000 to 3,000 No. 3-can capacity per 8-hour day*

Item	Description	Number required
Boiler	20 hp., upright or horizontal	1
Retort with inset crate.	106 No. 3-can capacity	2
Retort with inset crate.	33 No. 3-can capacity	3
Extra inset crate	106 No. 3-can capacity	2
Extra inset crate	33 No. 3-can capacity	3
Open-process tank	Approximately 50-gallon capacity or a size to accommodate the largest inset crate.	1
Steam-jacketed kettle.	40-gallon capacity	1
Steam coil	Tinned copper, to fit stockpot.	2
Sealer	Bench-type, heavy-duty, power-driven, 5 to 6 cans per minute.	3
Sealer	Bench-type, heavy-duty, hand-operated 3 to 4 cans per minute.	1 to 2
Exhaust box	3′ x 4′ x 14″ batch-type (covered).	2
Chain hoist	¼- to ½-ton capacity	1
Track and carriage	500-pound capacity, minimum.	(1)
Wash sink	Double-compartment sink, 4′ x 2′ x 18″ (for washing produce).	3
Wash sink	4′ x 2′ x 18″, double-compartment sink (for washing pots and pans).	1

Item	Description	Number required
Blanch and scald tank.	22″ x 22″ x 22″ (heated with steam coil).	2
Cold-dip tank	22″ x 22″ x 22″	2
Medium tank	15- to 25-gallon capacity for brine, sirup, etc. (heated with steam coil).	2
Cooling tank	6′ x 3′ x 3′ (metal)	1
Preparation table	10′ x 4′ x 34″	2
Meat table	10′ x 4′ x 32″	2
Fill table	10′ x 4′ x 34″	2
Sealer table	2′ x 4′ x 34″	2
Blanching basket	Wire mesh	12
Can tray	18 No. 3-can capacity	48
Cutting board	18″ x 12″ (hardwood)	(2)
Dishpans	12 to 16 quart	36
Dolly	For general transportation us in cannery.	2 to 3
Thermometer	Canning	8
Gage tester	Test gage and pipe assembly for testing pressure gages.	1
Can lifter	For lifting cans from exhaust box.	2 to 4
Gloves	For handling cans at sealer	(3)
Mill file	10″ for filing can seams	12
Magnifying lens	Small, for inspecting can seams.	1
Metal ruler	Standard, for measuring body and cover hooks of can seam.	2
Garbage can	20-gallon capacity with cover	6 to 8
Steam hose		(4)
Water hose		(4)

[1] 70 feet. [2] Optional. [3] Twelve pairs. [4] As needs require.

Note.—Other equipment needed will include fire extinguisher, marking equipment for cans, repair parts for equipment, tools for making repairs, and special equipment, such as large sieves, pulpers, meat grinders, and lard presses as needed. Paring knives, tomato-peeling knives, vegetable knives, and butcher knives should be provided by the cannery to standardize the types and sizes desirable. It is also desirable to provide labor-saving equipment, such as apple peelers and slicers, cherry pitters, bean cutters, pea shellers, kraut cutters. For suppliers of equipment see Partial List of Manufacturers, p. 83.

with steam. This size of boiler is adequate for plants having a capacity of 1,000 No. 3 cans per day. A plant with a capacity of from 2,000 to 3,000 No. 3 cans a day requires a 20-horsepower boiler. (See fig. 2.) It is preferable that the boiler size be in excess of anticipated needs as this will allow for expansion of the plant, if necessary. Equipment supplied with steam from the boiler includes the retorts, open-process tanks, exhaust boxes, steam-jacketed kettle, scald and blanch tanks, medium tanks, and closed coils used for precooking foods.

Water-feed system

The boiler must be equipped with a suitable water-feed system to replenish the supply of water in the boiler, as necessary. There is a constant drain on the water supply in the boiler where the condensate of the steam supply is dissipated as is the case in community canneries. While there are several types of water-feed systems, only the injector system is referred to here as it is the most common type used in canneries. The water may be supplied to the injector from an overhead tank, city water main, or a tank or barrel placed beside the boiler. The last-named plan is desirable for several reasons: A reserve water supply is available in case the city water pressure is cut off, the water supply can be easily checked, and there is not the problem of fluctuating water pressure as may be the case when the boiler is connected to a city water main. Figure 6 illustrates the steam injector with water supplied by suction lift from a tank or barrel placed beside the boiler.

Care must be taken to keep the barrel well supplied with water and to keep the water clean. The feed water, in passing through the injector, is heated by the steam to a temperature of about 150° F.; hence, the strain on the boiler is reduced proportionately. Steam is admitted to the steam nozzle from the supply pipe and, in passing into the combining tube, produces a partial vacuum in the suction, or water supply pipe, which causes the water to rise in the pipe and flow into the chamber surrounding the steam nozzle. The steam, passing at a high velocity into the combining tube, carries the water along with it. The energy contained in the steam is sufficient to carry the water across the opening between the combining and delivery tubes, raise the check valve, and force the water into the boiler against the boiler pressure.

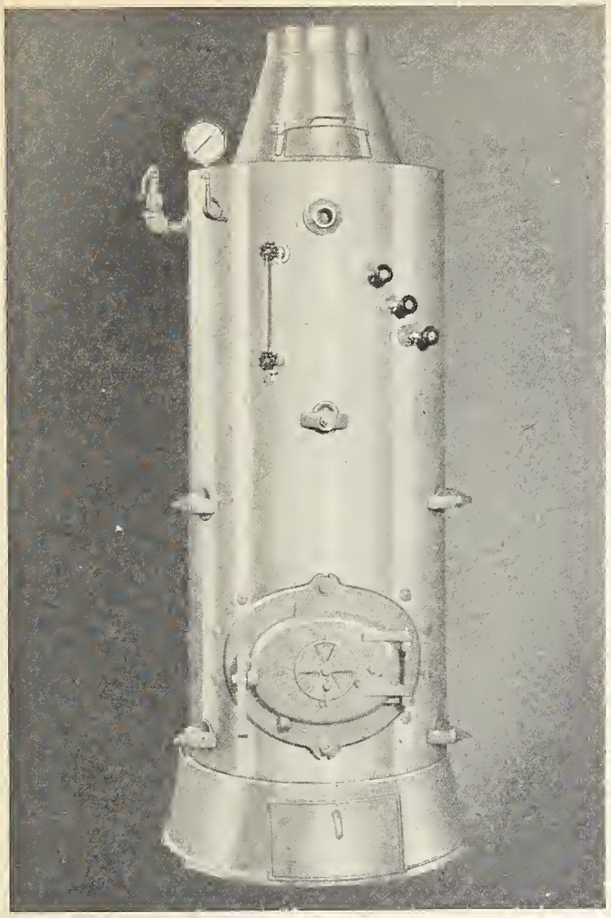

Figure 5.—Vertical coal-fired boiler.

In installing injectors, the steam supply should be taken directly from the highest point of the boiler, thus insuring dry steam at full boiler pressure. Steam for operating an injector should never be taken from a pipe supplying steam for other purposes, as the drop in pressure would probably be sufficient to prevent successful operation. An ordinary globe valve should be placed in the steam pipe connecting the injector with the boiler, for the purpose of starting and stopping.

The suction pipe must be absolutely tight for successful operation, as a slight leakage of air will destroy the vacuum formed in the pipe by the action of the steam jet. The pipe should be straight, if possible, as bends and elbows increase the friction and consequently decrease the flow of water. For short lifts, such as that illustrated by figure 6, the size of pipe should be the same as the connection to the injector. The suction pipe should run directly from the injector to the water supply. It should not be connected to a pipe supplying water for other purposes.

A globe valve should be placed in the suction pipe for the purpose of regulating the flow of water to the injector. The valve stem must be kept carefully packed at all times, as any leakage of air will prevent operation of the injector. Both a check and a globe valve should be placed in the delivery pipe, the globe valve being between the check valve and the boiler. With this arrangement, boiler pressure can be cut off and the check valve removed for inspection, cleaning, or repairs. Since it is necessary to supply water to the boiler before the boiler is fired a bypass water line should be provided in the injector assembly. A globe valve is provided in the bypass line for regu-

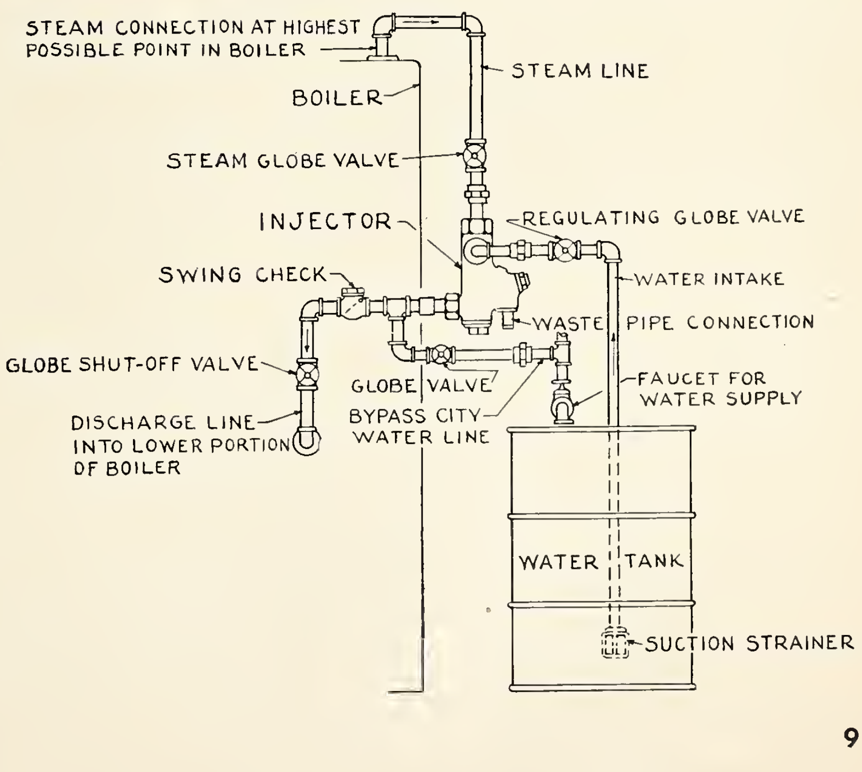

Figure 6.—Diagram of injector piping and valve arrangement.

lating the supply of water to the boiler. When water is delivered directly to the injector from an overhead tank or from city water mains a heavy pressure frequently exists and, in this instance, to facilitate starting on low steam, two globe valves are used in the water supply line. One valve is placed as near the injector as possible to regulate the water supply, while the second valve, placed several feet away, is employed to reduce the pressure. A strainer should be placed on the end of the suction pipe to prevent any foreign material from entering and possibly clogging the injector or check valves.

If the injector should fail to operate, a systematic search should be made to locate the cause. Some of the most common causes of failure to operate are the following:

1. The body of the injector and mixing tube becoming overheated by either—
   (*a*) leaky steam valve or discharge line check, or (*b*) being hooked in too close to the boiler proper.
2. Leaks in the suction-pipe valve.
3. Foreign matter deposited in tubes.
4. Strainer on end of suction pipe clogged.
5. Too low steam pressure for lift.
6. Too high steam pressure for lift.
7. Defective check valve.
8. Valve in suction pipe not properly regulated.
9. Absence of water at source.

It sometimes happens that an injector will lift water but will not force it into the boiler. This may be caused by a leak in the suction pipe, but it is more often caused by an obstruction in the delivery pipe between the injector and the boiler. This pipe often becomes choked with lime deposits. A test for obstructions in the delivery pipe can be made by connecting a steam gage between the injector and the boiler. If this gage shows a pressure much above that of the boiler, it indicates an obstruction of some kind in the delivery pipe.

The capacity of an injector should be at least 50 percent greater than the maximum requirements of the boiler it is to serve, as this provides against any heavy demands, and furthermore, the water supply can be reduced by throttling. On the other hand, if the injector is too small it is impossible to increase its capacity. When ordering injectors state the boiler horsepower, minimum and maximum operating pressure, and the method of supplying the water to the injector.

Location

The location of the boiler may be more or less predetermined by the nature of the building or the location in relation to surrounding buildings. However, it is most desirable to have the boiler as near as possible to the various pieces of equipment using steam, thereby reducing the length of the steam service lines and increasing the efficiency of the boiler. For safety, comfort, and cleanliness the boiler should be located outside the building if at all possible. (See fig. 2.) Where boilers are installed outside the building they should be properly housed for the protection of the equipment and the comfort of the firemen.

If it is necessary to install the boiler within the building it must be segregated from the main cannery room by a partition—at least a 12-inch brick wall—built in accordance with existing codes on such construction and there must be no door between the boiler room and the cannery. The boiler should be set level on a solid foundation, preferably of concrete. The height of the flue or stack should be determined solely by the size and type of boiler and the proximity of surrounding objects. The stack should be substantially constructed, properly guyed at intervals not to exceed 10 feet, and equipped with a flame arrester.

Local or State officials should be consulted before installing the boiler, as most States have boiler-inspection laws that must be complied with.

Boiler fittings and steam and water lines

Some important points to be considered in the selection and installation of boiler fittings and steam and water lines are:

1. The pipe size for the main header steam line from the boiler can be readily determined by the size of the tapping. In no instance should this pipe size be reduced if the full efficiency of the boiler is to be realized.

2. Careful consideration should be given in the selection of materials used in the installation of high-pressure steam boilers. It is false economy to purchase cheap fittings and valves of unknown quality. All pipes, valves, and fittings should be of standard 250-pound test. The design and construction of water valves differ from those of steam valves; therefore, no attempt should be made to use water valves in a steam line.

3. When cutting and fitting pipe, special care should be taken to see that all threads are clean and that all burs are removed from the ends of the pipes. Failure to do this will result in unsatisfactory operation because of leaky fittings and reduced capacity of the lines.

4. Before pipes are assembled, care should be taken to see that they are free of loose foreign material, such as filings, chips, or shavings, which might later lodge in and damage the delicate mechanism of such fittings as injectors and valves.

5. All thread connections and pipe joint make-ups should be coated with a good pipe thread compound to seal them against leaks and to facilitate uncoupling for repairs.

6. Y-type strainers should be placed in main steam and water feeder lines to catch all types of foreign materials and to facilitate cleaning of the lines.

7. The boiler safety valve and blow-down valve should be attached to the body of the boiler in the respective tappings designated by the manufacturer, and no attempt should be made to attach any other steam outlet or water feed to these openings.

8. Injectors, tube cleaners, or other apparatus requiring actual flow of steam should not be connected to the water column or to the gage glass fittings, as

this will cause the glass to show a false water level while such appliances are in use.

9. All steam lines should be adequately supported, and provisions should be made for the expansion of these lines when heated.

10. Where steam and water pipes are installed in parallel drops and the control valves are placed at the same height, adequate spacing should be given to insure free manipulation of the valves in order to prevent injury by coming in contact with the hot valve.

11. In making connections with various types of equipment, standard practice should be carried out—locating the steam pipe at the left and the water pipe at the right of the operator when facing them.

12. In the installation of steam and water lines, provision should be made at every low point to provide for the draining of such lines when freezing weather is threatened.

13. To keep steam lines free of condensate water, blow-down valves should be arranged at the end of each line, or steam traps may be provided for this purpose.

14. Where a drop line is provided for the attachment of a steam hose the connection should be made in a vertical position to prevent injury to anyone should the steam hose become loosened from the fitting.

15. All steam lines, fittings, and connections located in an exposed position in the working area should be insulated up to 7 feet above the floor to prevent injury to persons working in the plant.

16. Steam and water lines should be properly identified by the use of different colors of paint to prevent possible scalding of anyone mistaking a steam valve for a water valve.

17. Provisions should be made for the attachment of hose to the water lines at convenient places for washing floors and equipment.

Boiler operation

Because boilers are so varied in type, it is impossible to give specific directions on the operation of all kinds of boilers that will be used in community canneries. However, many of the general principles of operation apply to all boilers. Since the coal-fired vertical boiler is most commonly used, some of the important phases of its operation are given. To supplement these instructions it is recommended that all boiler operators be supplied with a copy of the book, Suggested Rules for Care of Power Boilers (*2*).[1]

The first duty of a fireman in preparing to fire a boiler is to check the water level. This is accomplished by two methods: (1) Ascertaining the level of the water as shown on the sight glass and checking to see if the sight glass is functioning properly. To do this, close both sight glass valves and drain the sight glass. The valves should then be reopened to see that the water returns to the same level as shown before. (2) Open and close all three try cocks to determine whether the sight glass shows the correct level. The water should flow only from the center and bottom cocks as the proper level should be halfway between the center and top try cocks.

It should next be determined that all valves in the boiler room are in proper position for operation. The main steam supply or header valve should be closed and valves on the water-feed system should be either opened or closed in accordance with instructions for the particular type of water-feed system used.

When the fire is started the draft door and stack damper should be opened; the grates should be in the proper position for firing and free from clinkers. Ashes should be scattered to a depth of 1 inch over the entire grate area before the fire is kindled. In the case of a new boiler installation, especially where it is bricked in, caution should be used so that the heat is not brought up too fast. Time should be given to allow the boiler to heat and expand slowly. In no case should a boiler be forced to reach the required pressure too rapidly. After the fire has started and while the boiler is warming up, steam valves on all equipment in the plant should be closed.

At this point, the seams, rivets, connections, and fittings should be checked to see that there are no leaks. No defects should be assumed to be safe. When the boiler reaches one-half the normal operating pressure it should be blown down and the safety valve tried by hand to see that it is functioning properly. The purpose of blowing down the boiler is to remove the accumulated sediment around the base of the tubes and at the bottom of the water pit. This is accomplished by very slowly opening the blow-down valve located at the bottom of the boiler to a fully open position until the water level in the sight glass is lowered by one-half. The blow-down valve is then closed and the water replenished in the boiler to a normal operating position. When the boiler reaches the normal operating pressure the fireman should notify the supervisor that he is ready to turn the steam into the supply lines. It is important for the supervisor to see that no one is repairing steam lines at this time and that patrons and employees are warned that the steam is being turned into the lines.

The main steam supply valve should be opened very slowly at first, a little time being allowed for the lines in the plant to warm up before opening it widely. This will prevent undue strain on the lines and fittings.

The supervisor should acquaint the fireman with the steam needs for various products and processes so that the fireman will know when extra demands will be made for steam. A more satisfactory operation will result if the fireman is able to build up the steam supply before the demand actually occurs. Fire is maintained in the boiler by adding the fuel in small amounts at frequent intervals. This results in more complete combustion and a quicker response to peak loads of steam when required than do large quantities of fuel added at less frequent intervals.

It is good operating practice at some time during

[1] Italic numbers in parentheses refer to Literature cited, p. 85.

each day's operation to build up the steam sufficiently to check the operation of the safety valve at the pressure for which it has been set. As the safety valve opens, the number of pounds of pressure on the steam gage should be noted and should check with the pressure at which the valve was set.

The water level in the boiler should be watched carefully and the water-feed system should be started to operate well in advance of the actual demand for water. This gives the operator some leeway in case difficulty is encountered in operating the water-feed system. If for any reason the gage shows that the water has fallen to or below the point designated by the manufacturer as a minimum operating level, no attempt should be made to feed water into the boiler. All valves should be left as they are and the fire withdrawn from the grates. The fire door should be left open so that the draft created through the tubes will cool the boiler to a point where it is safe to replenish the water supply. If the gage glass is not equipped with chain-operated, quick-closing valves, it is recommended that a common broom be kept near the boiler at all times. In case of a broken glass the broom may be used to prevent scalds in shutting off the sight-glass valves. It should be pushed over the valve stem, the broken glass, and the valve head so that the straws will break the force of the escaping steam and water and give the operator a chance to close the valves without being scalded. The bottom valve should be turned off first; the top valve closed last. With the steam and water shut off, the glass may be replaced.

Owing to the fact that excess oil, gas, compounds, and lime sediment may have accumulated in the boiler, a condition called foaming and priming may occur sometimes. This is indicated by the presence of foam and the rapid rise and fall of the water level in the sight glass. If the water level is high enough, the boiler may be blown down and the water supply replenished. By repeating this process several times the condition may be corrected. In extreme cases, however, it may be necessary to wash down the boiler. The job of washing down the boiler should be done when the boiler is cold. It will be necessary to remove all handhole and manhole plates and start at the top of the boiler, washing inside with a hose. In this manner the sediment is washed down to the lowest point from which it is possible to remove it from the boiler. Before handhole and manhole plates are replaced, the gaskets and surfaces which they contact should be examined to see that they are clean and smooth. The gaskets should be painted with a mixture of graphite and oil to keep them soft and pliable. The necessity for washing down will vary according to the frequency of use and the local water supply but the job should be done often enough so that at no time will there be an excessive accumulation of sediment for the type of boiler used.

An accumulation of soot in the tubes of a boiler reduces the efficiency because it acts as an insulation. It should be removed, therefore, as often as necessary to permit direct contact of the heat with the tubes. This is usually accomplished by drawing a scraper or wire brush back and forth through the tubes to dislodge the deposits. The frequency of this condition and the need for cleaning will vary with the type and quality of fuel used and the frequency with which the boiler is used. The boiler tubes should be blown out daily with steam.

In some localities where the water supply is of such composition that it is necessary to treat the feed water or to use boiler compounds to prevent scale, corrosion, or wet steam, a qualified water chemist or a steam engineer should be consulted. No attempt should be made to use boiler compounds or to treat feed water without first making an analysis of the feed and blow-down water and the condensate from the steam mains at the plant. If it is determined that treatment is necessary it is recommended that the closed-coil system of heating, rather than the perforated pipes, be used where the food comes in contact with the water or steam, as in blanch and scald tanks, medium tanks, precooking kettles (other than steam-jacketed kettles) and exhaust boxes. (The closed-coil system of heating these items of equipment is illustrated in this publication.)

Caution: The safety valve should be set by a qualified boiler inspector at the time the boiler is installed and should never be changed except on the advice of a boiler inspector. The safety valve should be kept free at all times and properly lubricated. The pipe from the blow-down valve should lead to a sump or pit, or a baffle should be placed opposite the end to prevent scalding of persons coming in contact with it. If the boiler grates are equipped with a detachable shaker bar, it should be kept in place, or hanging in a convenient place near the boiler, at all times because its use may be necessary in withdrawing the fire in case of an emergency, such as loss of water in the boiler.

The boiler room should be kept clean and in order at all times and no tools or obstruction should be permitted to remain on the floor or at a point that would hamper the operation of the boiler system. Boiler-room doors should open outward and should never be bolted. Boiler rooms should be properly ventilated to prevent an accumulation of gases. Persons not immediately concerned with the operation of the boiler should never be permitted in the boiler room. The boiler should be attended and operated in accordance with State and local codes.

Retorts

A steam retort is a closed pressure vessel designed for processing canned foods under steam pressure. All nonacid vegetables, meats, and fish are processed under steam in order to attain temperatures sufficiently high to destroy spore-forming bacteria that may be present.

Type and number of retorts

Vertical retorts of less than 200 No. 3 can capacity are most commonly used in community canneries. It is well to provide retorts of 33 No. 3 can capacity

in combination with larger retorts to allow for flexibility necessary for processing small or large quantities. To determine the number of retorts needed, divide the total anticipated daily output of nonacid foods by the daily output per retort. On an average, retorts will be loaded six to eight times a day, depending on the produce processed. It is best to figure the number of retorts needed on a basis of six loadings per day so that capacity is provided for peak production periods.

Retorts, often referred to as unfired pressure vessels, should be purchased from a reputable manufacturer who can be depended on to furnish equipment of a design that is adequate for the intended service. Some States have laws controlling the specifications of unfired pressure vessels used in canning plants, while others do not. It is recommended, however, that in all instances only those retorts be purchased which are constructed in accordance with the Unfired Pressure Vessel Code of the American Society of Mechanical Engineers (*1*) and bear its seal.

Retort equipment

Retorts used in community canneries should be of steel welded construction and equipped with a number of lugs for holding on the lid. They should also be equipped with a mercury thermometer, pressure gage, safety valve, vent, and pet-cock bleeder. A gasket, preferably fitted into the flange of the retort body, is provided for the purpose of making a seal between the lid and the retort flange.

Mercury-in-glass thermometer

The mercury, or indicating, thermometer is the official instrument by which processing is done. It should be graduated in 1° to 2° divisions and should read from 170° to 270° F. The bulb of the indicating thermometer should be installed preferably in an external well or pipe attached to the side of the retort body. (See figs. 9 and 12.) The thermometer bulb should clear the surrounding walls of the external well or pipe by at least ⅜ inch. The well or pipe must be equipped with a ⅛-inch pet-cock bleeder so located as to provide a full flow of steam past the entire length of the thermometer bulb. The bulb of the indicating thermometer may be installed within the lid of the retort provided the entire bulb extends below the lid where it is completely exposed to the flow of steam.

Pressure gage

The pressure gage should be graduated in 1-pound divisions and should have a range from 0 to 30 pounds. The gage should have a minimum 3-inch and preferably a 5-inch dial and should be of a type in which the operating mechanism is independent of the case. Pressure gages and thermometers should be so placed with respect to light and position that they may be easily read.

Vent and bleeder

All retorts used in community canneries should be equipped with a venting outlet of at least ⅜- to ½-inch diameter and preferably larger. The vent should be controlled by a quick-opening gate-type valve which permits a free flow of air from the retort during the coming-up time. A globe valve should not be used as it will greatly reduce the venting efficiency. The vent should be placed in the top of the retort opposite the steam inlet at the bottom. In addition to the vent a ⅛-inch bleeder should be provided in the retort lid. Inasmuch as it is kept partially open throughout the processing period it should be arranged in such a way that the operator can observe that the steam is emitting. In many instances the ⅛-inch pet-cock bleeder is the only provision made for venting the retort. Such a bleeder is very inadequate for venting retorts and should be supplemented with a valve-controlled vent as specified above.

Safety valve

A safety valve of the same size as the steam inlet is recommended because the retort is hand-controlled and it might be possible to develop the full boiler pressure in the retort if this valve were not sufficiently large. ***The safety valve, located in the lid of the retort, should be set to blow from 2 to 5 pounds above operating pressure.*** Vent valves, safety valves, and pet-cock bleeders should be so placed that steam may not be discharged in the direction of the operator. It is well to provide a shield on the safety valve so that persons near the retort will not be burned by the steam if the valve opens to release the pressure.

Retort inset crate

An inset crate must be provided for holding cans in the retort. It is well to provide an additional crate for each retort to give the capacity needed for loading cans preparatory to processing. These crates should preferably be of strap-iron material or heavy wire. If perforated sheet-metal crates are used they should have 1-inch holes on 1½-inch centers or the equivalent. Sheet-metal crates with too few perforations should not be used, for they retard the removal of air from the retort and do not permit a full flow of steam around the cans. This may cause serious underprocessing owing to air pockets that may be present.

Installation of retorts

For efficient use of steam and economy of operation, retorts are placed near the boiler. In community canneries they are usually installed in a straight line. Where retorts of different sizes are used care must be taken so that they are centered in line to facilitate the removal of retort crates with the overhead hoist. Two ways to make the best use of floor space required for retort installation in a rectangular building are demonstrated in figures 7 and 8.

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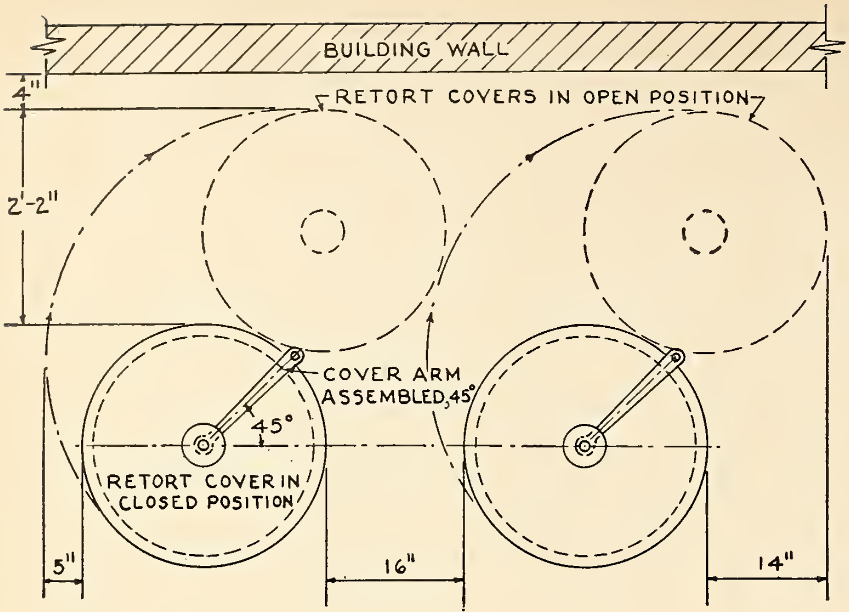

Figure 7.—Plan for installing retorts with cover arm assembled for 45° swing.

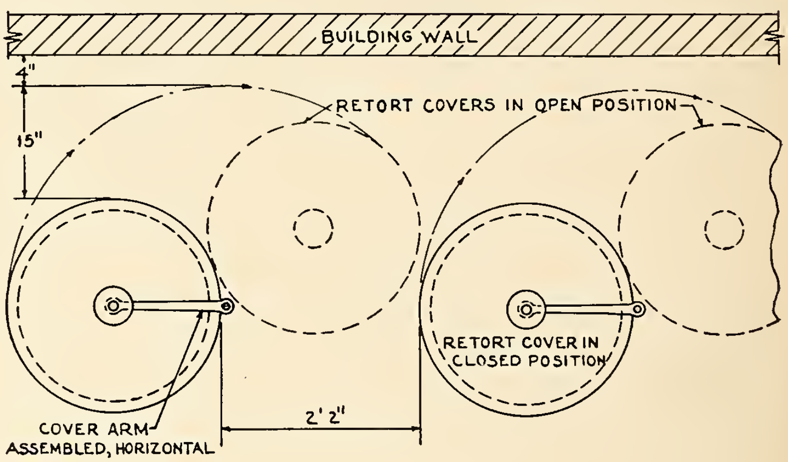

Figure 8.—Plan for installing retorts with cover arm assembled in horizontal position.

Where it is necessary to make an installation across the narrow end of a building or in any area where the length of the installation is restricted, it is possible by proper location of the cover cranes to group the retorts in such a manner that the minimum distance between retorts will be obtained. This necessitates their installation farther away from the wall than ordinarily would be necessary. Where retorts are to be installed lengthwise of a rectangular building and where conservation of the width of the building is a prime factor, by proper location of the cover crane the retorts may be placed so that the distance to the wall will be held to a minimum. This method requires more distance between retorts than the first method but valuable space in front of the retort is conserved. The placement of retorts in relation to each other will of necessity vary with the size of the retort. In all cases the distance from the wall and the distance between the retorts should be ample enough for a cover to swing open without striking an adjacent retort or the wall. After being alined, the retort should be fastened securely to a low, sturdy bench or supported by legs secured to the floor, allowing enough space under it for making the necessary pipe connections.

Figure 9 shows a satisfactory piping arrangement for installing a single retort to be used for processing only. The steam line should be ¾ inch in diameter and should enter the retort at the bottom in such a way that steam will be directed up into the load of cans. In retorts that are to be used for processing and pressure cooling it is advisable that the steam line lead to a perforated pipe which crosses at right angles near the bottom of the retort. (See fig. 12.) This will assure an even distribution of steam during processing and pressure cooling. The pipe should be per-

forated with eight ¼-inch holes to 1 foot of pipe. The perforations should be on top of the pipe so that the steam can be directed upward around the cans.

Although retorts constructed in accordance with the code set up by the American Society of Mechanical Engineers (*1*) may be supplied with steam from a high-pressure line, it is recommended that they be supplied from a low-pressure line. Retorts that do not meet the requirements of this code must be supplied with steam from a low-pressure line. This is accomplished either through the use of a pressure-reducing valve installed in the steam line leading to each retort (see fig. 9) or through the use of a single pressure-reducing valve installed in the main steam line leading to a battery of retorts (see fig. 10). The former method is preferred in that the pressure to each retort is not affected when other retorts are put into operation as might be the case when a single pressure-reducing valve is used to control the pressure to a battery of retorts. Furthermore, if the pressure-reducing valve to an individual retort should fail to function, only that retort would be affected. Either a pilot-operated or spring-type valve may be used for installations to single retorts. If a single pressure-reducing valve is used to control the pressure to a battery of retorts, a pilot-operated valve is recommended as a closer degree of regulation can be obtained than with the spring-type valve. In the latter case a bypass steam line should be installed around the regulator so that the pressure can be controlled manually if for any reason

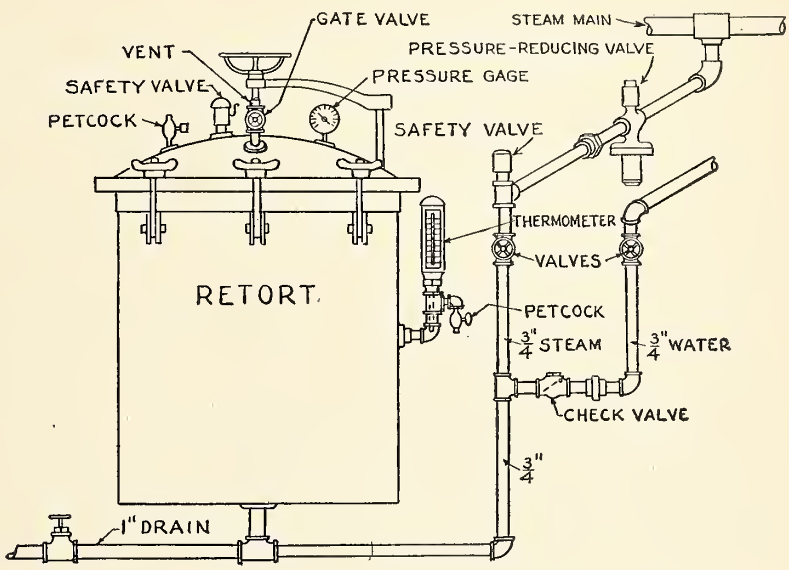

Figure 9.—Diagram of piping arrangement to single retort for processing only.

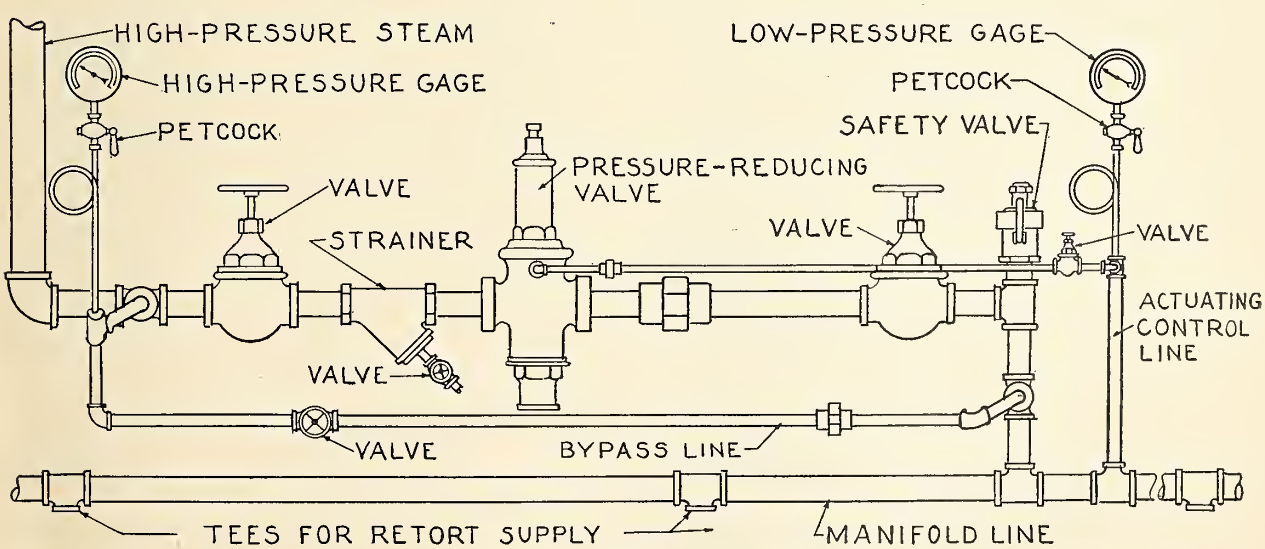

Figure 10.—Diagram of piping arrangement of pilot-operated pressure-reducing valve in main steam line leading to a battery of retorts.

it is necessary to remove the regulator from service. (See fig. 10.) Only an experienced person should be permitted to adjust the pressure-reducing valve or operate the steam valves of the bypass line.

A pressure-reducing valve should be installed near the equipment it is to control and should be set so as to reduce the pressure from the high-pressure line to a pressure from 3 to 5 pounds above that at which the retorts are operated. As a protection against the failure of the pressure-reducing valve, a safety valve of the same size as the low-pressure pipe line should be provided between the pressure-reducing valve and the retort and should be set to pop off at 5 to 10 pounds higher than the pressure at which the retorts are operated. In all instances where a pressure-reducing valve is used, a strainer should be provided in the steam line leading to the regulator valve to prevent dirt or other foreign matter from accumulating on the seating surface. Individual strainers are not necessary where pressure-reducing valves are provided for each retort if the strainer is placed in the steam supply line. A Y-type strainer is recommended as it may be easily removed for cleaning. The port seats of the valve should be of stainless-steel trim or other equally noncorrosive metal if satisfactory performance is to be assured over a long period of time.

It is important from an operating standpoint as well as that of cost that the regulator be correctly sized. The size should be determined on the basis of the work to be done rather than by the size of the existing pipe lines. When ordering pressure-reducing valves, state the boiler pressure and the pressure at which the retorts are to be operated, as well as the number and size of retorts that are to be operated off the low-pressure line.

It is well to provide a water-inlet pipe line to retorts to assure flexibility in operation. Retorts may then be used interchangeably for water-bath and steam-pressure processing. (See fig. 9.) A water-inlet line must be provided for retorts that are to be used for pressure cooling. A retort of 106 No. 3 can capacity is the smallest recommended for pressure cooling. (See fig. 12.) The water pressure should be at least 10 pounds greater than the pressure used in processing. An overflow pipe line not less than 1 inch in diameter, fitted with a gate valve, must be provided on any retort used for pressure cooling. If the discharge end of the overflow line is under water or if the line is connected to a drain line, as shown in figure 12, the overflow line should be broken, as at D, in order to prevent a vacuum from being drawn in the retort. It is preferable to use a funnel connection, as shown in figure 12, as such installation permits ready inspection of the volume of water passing out. All retorts must be provided with an adequate drain not less than 1 inch and preferably 1½ inches in diameter connected to a sewer or discharged into a floor drain, as desired. A retort used for pressure cooling requires a minimum drain 1½ inches in diameter and, if the drain line is more than a few feet long, a 2-inch drain would be advisable. This provision is necessary to aid in the rapid removal of water from the retort during pressure cooling and the removal of air from the retort when the overflow pipe is used for venting. A smaller drain pipe may restrict the removal of water or air from the retort. All pipes should be reamed in order to assure full capacity. They should also be blown out to remove particles that may cause the valve seats to become scored.

The arrangement of fittings and connections, shown in figures 9 and 12, may need to be modified to meet local conditions. However, steam and water valves should be so located that each may be readily reached and the operator will be able to watch the pressure gage and thermometer.

Care of retorts

In community canneries where retorts are used but seasonally the entire retort hook-up should be examined carefully at the beginning of the canning season and each retort should be brought up to processing temperature without a load. At this time carefully inspect the steam line for leaks; check the vents, bleeders, safety valves, gages, and thermometers. All valves should be gone over to see that they seat properly and operate freely. Gages and thermometers should be tested for accuracy before the plant is put into operation and at least once during the canning season. The retorts should be thoroughly cleaned with a wire brush to prevent loose scale or rust from getting into the valves during operation. The gasket in the retort flange must be maintained in good condition by treating it at frequent intervals with a solution of graphite in oil. This prevents it from sticking and helps to make a good seal. When the gasket becomes worn, it should be replaced. An extra gasket should be on hand for replacement. When a new gasket is installed, it should be joined with an angular overlapping join because a certain amount of shrinkage will develop after it has been used a short time and the angular join prevents leakage when this occurs. Be sure that retorts are thoroughly drained and permitted to dry at the end of each day's operation to prevent rust and stale odors that might otherwise occur. It is well to fill the retort with water occasionally and boil it out to remove grease or other foreign matter.

Retort operation

When a retort has been idle for an hour or longer, the steam line should be blown out immediately before using. This can be accomplished by closing the lid of the retort and turning on the steam for a minute or two until live steam, free from air or condensate, flows from the line. Thereafter during the day, if the retort is in constant use, it will not be necessary to repeat this procedure. After blowing out the steam line close the steam valve, open the lid, and place the crate of cans in the retort, readjusting the lid into position. Lift all lugs into place. Do not tighten any until they are all up. This insures that all lugs can be raised into position. Fasten

lugs by hand until tight. Turn opposite lugs, working back and forth across the head of the vessel until all lugs are tight. Do not start at one point and go around the lid because this will put a strain on the lid. Furthermore, it may cause some lugs to become loose when the pressure builds up in the retort, and accidents may occur.

It is necessary to fasten the lid only securely enough to prevent the escape of steam between the lid and the retort. In using a retort for the first time, the position of the cover in relation to the body should be marked so that the cover may be replaced every time in the same position. This will prevent damage to the gasket and avoid the possibility of leaks from that source.

In following the instructions given in this publication for processing nonacid canned foods, the operator must make sure that the product has been heated in the retort in pure steam at the temperature specified for the length of time recommended.

Venting retorts

Retorts, even when fully loaded, contain considerable air, which must be completely replaced by steam before the process is begun. Retorts only partially filled contain considerably more air than those with a full load. Air trapped between the cans within the retort load produces air pockets or low-temperature spaces in which the cans are not fully processed. Air acts as an insulator and, when present, will cut down the penetration of the steam. The transfer of heat to the cans is very much faster from steam than from a steam-air mixture. It is imperative, therefore, that all air be removed from the retort before starting the process if the full value of the process is to be realized and spoilage avoided. This is accomplished by venting the retort. Since air pockets may persist for a considerable length of time, the retort must be vented for a predetermined period of time.

To determine the adequate venting times for community cannery type retorts, a study by Fitzpatrick, McConnell, and Esselen (7) was conducted at the Massachusetts State College and the following recommendations were made:

No. 2 steam retorts (33 No. 3 can capacity) should be vented at least 7 minutes at 0 pound or 10 pounds pressure.

No. 3 steam retorts (106 No. 3 can capacity) should be vented for at least 25 minutes at 0 pound pressure, or 10 minutes at 10 pounds pressure.

It is well to vent all retorts under pressure to assure the removal of air pockets, and in the case of the larger retorts, to shorten the time for venting.

To vent these retorts adequately within the period of time given, it is important that the venting outlet be of sufficient size to permit the rapid removal of air. (Vents provided should be of the size recommended on page 13.) The ⅛-inch pet cocks usually provided on retorts are not large enough to function as vents but serve only as bleeders to prevent the accumulation of noncondensable gases that may be introduced with the steam. Other factors that need to be considered to assure adequate venting of retorts are the steam supply, the equipment used for holding the cans in the retort, and the arrangement of cans in the retort crates. A ¾-inch steam-inlet line should be the minimum size provided for retorts that are to be vented in the time recommended. Retorts having only a ½-inch steam-inlet line will need to be vented at least 5 minutes longer than the time recommended to assure the removal of air pockets. The type of crate and the arrangement of cans which permit a free flow of steam in all directions around the cans are illustrated in figure 11. (For further information on the stacking of cans in retort crates see page 57, and for information on the use of perforated crates see page 13.)

To vent a retort, open wide the vent valve or the pet-cock bleeder on the retort lid. Also open wide the pet-cock bleeder on the thermometer pocket, as air trapped in the pocket will reflect a false reading. Make certain that the water-inlet valve and the drain valve are closed. Open the valve of the steam supply line gradually until a flow of steam comes into the retort. Do not count the venting time until a steady stream of steam issues from the vent or pet-cock bleeders. The presence of air pockets in the retort is not indicated by the retort thermometer or pressure gage, even though they may be in agreement. Therefore, venting must be continued for the predetermined time necessary to assure the removal of all air.

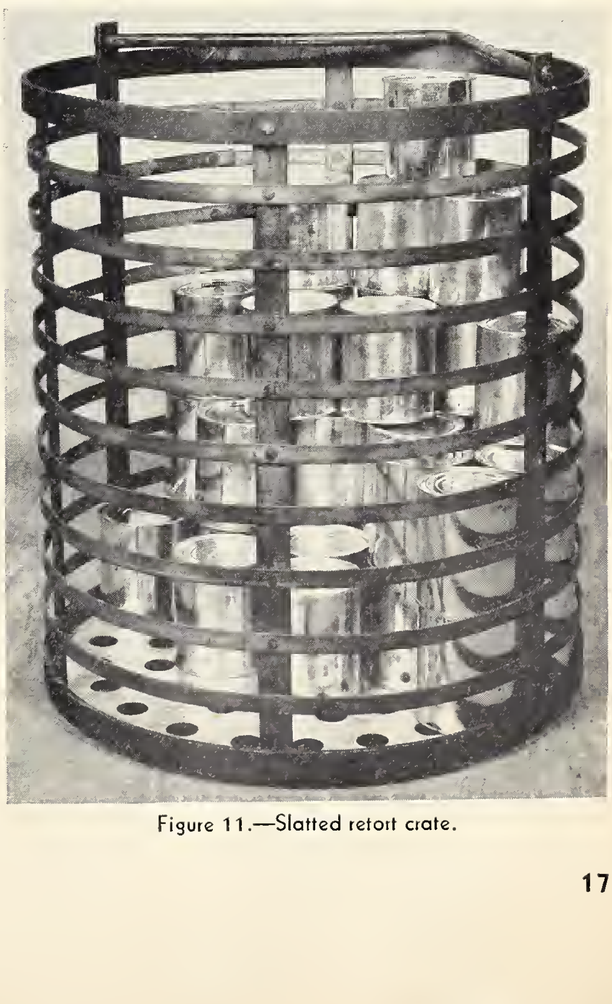

Figure 11.—Slatted retort crate.

Processing

At the end of the venting period the vent valve or top pet-cock bleeder and the thermometer bleeder should be partially closed so that approximately half of the full flow of steam is emitted. They are left in this position throughout the entire processing period, thus permitting the essential circulation of steam throughout the retort and past the thermometer bulb. Processing time is counted as soon as the thermometer indicates the processing temperature desired and is in agreement with the gage pressure. (See table 8 for gage pressure corresponding to specified process temperatures at various altitudes.) Compute the time in which processing is to be done and record it on the retort or on a clock face or pad. A small square marked off on the retort with blackboard paint makes a very satisfactory place to record processing periods. Chalk may be used and erased with each processing. To avoid confusion when recording processing time on a pad or clock face, it is important that the retorts be numbered for identification and the appropriate number be recorded on the pad or clock face.

The correct temperature in the retort is maintained by regulating the bottom steam-inlet valve. Retorts should be watched carefully throughout the processing period. Fluctuations in temperature or pressure may result in underprocessing or overprocessing. Furthermore, these fluctuations cause undue strain on the can seams. If the temperature or pressure is permitted to drop, it may be necessary to lengthen the processing time, or to reprocess, in order to prevent spoilage. (See p. 58.) The practice of depending on pressure-reducing valves as a control of the retort pressure should be discouraged as this is not a protection against a drop in boiler pressure. Furthermore, these valves may get out of adjustment or fail to operate. At the end of the processing period the steam supply line to the retort should be closed and the retort left to vent until the pressure gage reaches zero before the retort cover is removed. Too rapid venting at the end of the processing period may cause cans to buckle. When No. 3 cans are used, pressure should be released slowly, and the pet cock adjusted to about one-half open. When smaller cans are used, pressure may be released more rapidly. However, the pet cock should be opened gradually as the pressure goes down. When the gage-pressure reading is at zero, open the retort promptly and remove the cans for cooling.

Pressure cooling of cans in retorts of 106 No. 3 can capacity or larger (pressure maintained with steam)

Cans of larger diameters, such as No. 5 and No. 10, if processed under pressure, must be cooled under pressure. Otherwise, the ends of the cans may buckle when the steam pressure is permitted to drop after the cooking is completed. This buckling is caused by excessive pressure inside the can as opposed to the lower atmospheric pressure outside the can. Such excessive pressure, in addition to disfiguring the can, may overstrain the double seam and cause spoilage owing to leakage. This pressure differential can be reduced only by lowering the temperature of the can contents before the pressure in the retort is permitted to drop. If buckling has been experienced in cans of smaller diameter (such as No. 2, No. 2½, and No. 3), processed under pressure, they should also be cooled under pressure.

Pressure cooling may be accomplished by maintaining the pressure either with steam or compressed air. Where compressed air is available the use of this method is more desirable. However, since most community canneries will of necessity be limited to the method in which the pressure is maintained with steam during part of the cooling period, instructions are given for that method.

Figure 12 illustrates a typical retort installation with minimum pipe connections to permit pressure cooling. The pressure is maintained with steam.

Retorts in which cans are to be pressure-cooled are operated according to the preceding instructions, with the following exceptions:

1. Before putting the crate in the retort, admit from 6 to 8 inches of water and turn on the steam to bring the water to the boiling point. This provides a cushion of water in the retort to prevent condensation of the steam when water is admitted at the beginning of pressure cooling.
2. Before starting the venting process close the steam valve *A* in the steam supply line coming in at the top side of the retort.
3. When venting the retort, open the gate valve *E* in the overflow line and leave it open throughout the venting period. At the end of the venting period completely close this valve.

At the end of the processing period the following points should be observed for pressure cooling all large diameter cans, and small sizes where necessary.

Open the steam valve *B* an additional quarter turn or more to build up the pressure slightly above operating pressure. Give water inlet valve *C* about a quarter turn. Let stand a few minutes and repeat until a full flow of water comes into the retort. It is extremely important at all times that the water be admitted to the retort gradually, and particularly so where the water pressure at the retort is in excess of 50 pounds.

Continue admitting steam and water together until the layer of hot water has been increased by several inches in the retort. This will usually require 2 or 3 minutes.

As the layer of hot water builds up, turn off the lower steam valve *B* gradually until it is completely closed and cold water is being admitted under the layer of hot water. This layer of hot water prevents the steam in the top of the retort from condensing and thus makes it possible to maintain a pressure on the cans.

The pressure should be held at or above the normal operating pressure. This is accomplished by opening the top steam-inlet valve *A* as the bottom steam valve *B* is closed.

As the retort fills with water, there will be little use for steam to hold the pressure because it will be

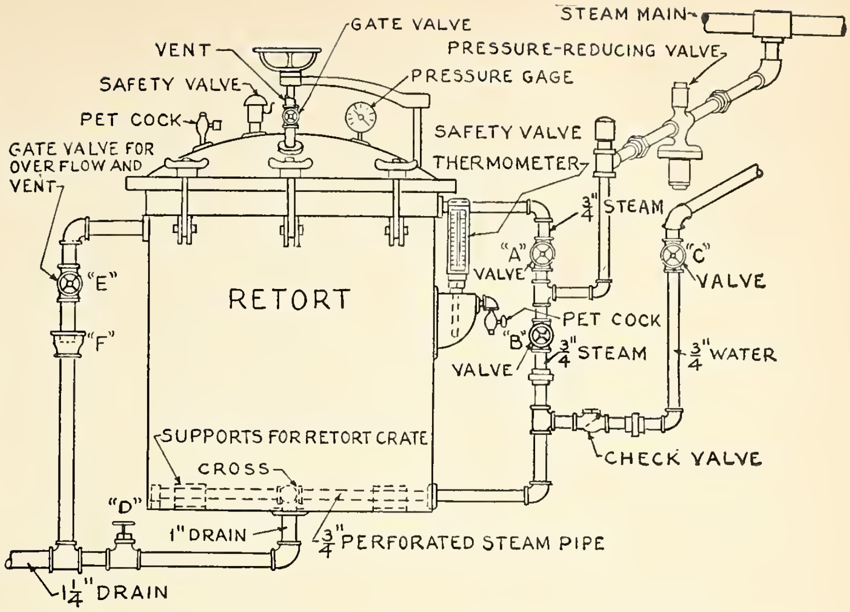

Figure 12.—Diagram of piping arrangement to single retort for processing and pressure cooling.

maintained by the water pressure. However, continued observation and adjustment of valve *A* will be necessary. When the water level reaches the pet-cock bleeder on the thermometer it should be closed and valve *A*, top steam inlet, should be closed. It will be noted that the mercury column of the thermometer drops rapidly. When the retort is about full the water will shoot out of the pet-cock bleeder or the vent valve on the retort lid. Close the bleeder or valve, and at once partially open the overflow valve *E* and cut back the flow of water by partially closing valve *C*. The retort pressure should be kept the same as, or slightly higher than, the processing pressure during these operations, care being taken so that the pressure never exceeds the processing pressure by more than 5 pounds. Adjust the water-inlet valve *C* and the overflow valve *E* so as to maintain the desired flow of water through the retort at the desired pressure. With practice one can soon learn the exact method of handling valves during this stage.

Great care must be exercised to prevent excessive pressure as the retort fills with water. The retort operator must make every effort to keep the pressure constant. Practice with an empty retort until details are mastered. When the retort has filled with water it should be held at the normal operating pressure and the water allowed to run through the retort freely until the cans have been cooled, so that when the water pressure on the retort is relieved the cans will have no more internal pressure than is displayed by a springer. Because the top row of cans cool more slowly than the other rows, observation should be made of these and determinations set up for each product as a guide for cooling time required.

Products, such as peas, string beans, beets, and carrots, which heat by convection will cool rapidly and will require but very short holding periods under pressure after the retort is full of water. There will be cold water circulating in through the bottom and hot water out through the overflow. When the water flowing out of the overflow pipe is cool enough so that the hand may be held on the pipe, the pressure may be dropped and the retort lid removed. This should be done gradually at the rate of 1 pound per minute until 0 gage pressure has been reached. This is accomplished by opening the overflow valve *E* until all the pressure is out of the retort. When this occurs the water inlet valve may be closed tightly and the lid removed. Cooling should be continued after the lid is removed by maintaining the abovementioned circulation until the cans are just warm when placed to the cheek.

Other products which heat by conduction, such as pumpkin or cream-style corn, will require longer periods for cooling under pressure. This period may vary from 20 to 25 minutes. When such products are cooled the retort should be held at full pressure to within 10 minutes of the end of the cooling period and then the pressure should be dropped at the rate indicated. It is best to drain the retort before the cans are removed to prevent spilling water on the floor. In pressure-cooling the following rules should be observed:

1. Keep valves well oiled so that they work freely.
2. Fill retort full of water as rapidly as possible to prevent overcooking top cans. Cut back the flow of water as soon as retort is sufficiently filled to cool cans in desired time.
3. Maintain a constant pressure in retort while it is being filled with water. Slowly reduce pressure thereafter.
4. To prevent buckling of cans and overstraining of seams do not relieve retort pressure too abruptly.
5. To prevent paneling at sides of cans do not cool too long under pressure.
6. Observe the top cans for the effects of too-short cooling under pressure and the bottom cans for the effects of too-long cooling or too much pressure during the later stages. Too great a differential between the results on top and bottom cans may indicate that the retort has been too slow in filling or that too small a flow of water has been going through while cooling.

Testing pressure gages

Since pressure gages sometimes get out of order they should be tested at the beginning of the canning season and at frequent intervals thereafter as long as the retorts or pressure canners are in use. This is particularly important where pressure gages are the only means provided for determining the temperature inside the vessel. Pressure gages are best tested by the use of dead-weight gage testers or manometers but since many canneries find their cost prohibitive an inspector's test gage is often used instead. Figure 13 illustrates the assembly necessary for using an inspector's test gage.

This method of testing gages is satisfactory provided the inspector's test gage is checked periodically for accuracy against a dead-weight gage tester or a manometer. State colleges and railroad shops usually have these facilities.

If a test gage is to be used for testing pressure gages on retorts and pressure canners it should be of the following specifications:

1. Inspector's test gage.
2. Three-inch dial.
3. A pressure range of 0 to 30 pounds per square inch, with total scale graduations of not less than 270°.
4. The smallest graduation not greater than ¼ pound per square inch.
5. Accuracy guaranteed within one-half of 1 percent of maximum scale graduation.
6. One-fourth-inch bottom connections.

(See partial list of manufacturers (p. 83) for suppliers of test gages. The piping and fittings to make up the test-gage assembly may be purchased at any hardware store.)

Figures 14 through 25 illustrate the parts of an inspector's test-gage assembly and the method for testing pressure gages on pressure canners or retorts heated with a direct flame. Pressure gages on retorts heated with steam from a boiler are tested in the same manner except, of course, that it is not necessary to put water in the retort.

Steps in testing pressure gages are:

Step 1: Fill the vessel with 2 to 3 inches of water. Close the lid of the vessel and fasten into position. Remove the pressure gage with a bicycle wrench.

Step 2: Replace pressure gage with ¼-inch T (part 2, fig. 14) and screw canner gage into top of T. In screwing gage into T use two wrenches, as shown, to support the T properly.

Step 3: Remove the ¼-inch pipe plug (part 3, fig. 14) from the T. Screw the ¼-inch nipple with union connection (part 4, fig. 14) into T, using bicycle wrench and supporting gage with hand.

Step 4: Pour water into siphon (part 5, fig. 14) until it comes out at the bottom. Water in the siphon prevents the hot steam from entering the test gage. Keep siphon upright to prevent loss of water.

Step 5: Mount siphon in position in the ¼-inch union connection and tighten with wrench. Support siphon with hand so as not to place strain on the pipe connection into canner.

Step 6: Place inspector's test gage (part 6, fig. 14) in position and tighten union connection with wrench, supporting pipe assembly with hand.

Step 7: Apply heat to canner or retort, leaving the vent valve or pet-cock bleeder open until steam issues freely from the vessel. Close the vent or pet cock to permit pressure to build up in the vessel. As the pressure rises tap the pressure gages lightly at the center of the dial to correct any tendency of the pointers to stick.

Step 8: Test pressure-canner gage at 10 and 15 pounds per square inch by bringing the test gage to these pressures and observing the corresponding reading of the canner gage. Be sure the test-gage pointer is at the correct pressure at which the test is being made. If the test-gage pointer exceeds the correct value, open the vent valve to release pressure. Note carefully the reading of the canner gage at each test pressure (10 pounds and 15 pounds per square inch). When the test is completed, turn off the heat.

Step 9: Open vent valve wide to relieve pressure in vessel. Do not attempt to remove testing assembly until pressure has returned to 0. Remove test gage first, then siphon, and then union nipple, supporting piping assembly with hand at each step to prevent strain on connection in lid. Leave the ¼-inch T and gage assembled. By leaving this assembly in position future tests can be made without disturbing the pressure gage on pressure canner or retort.

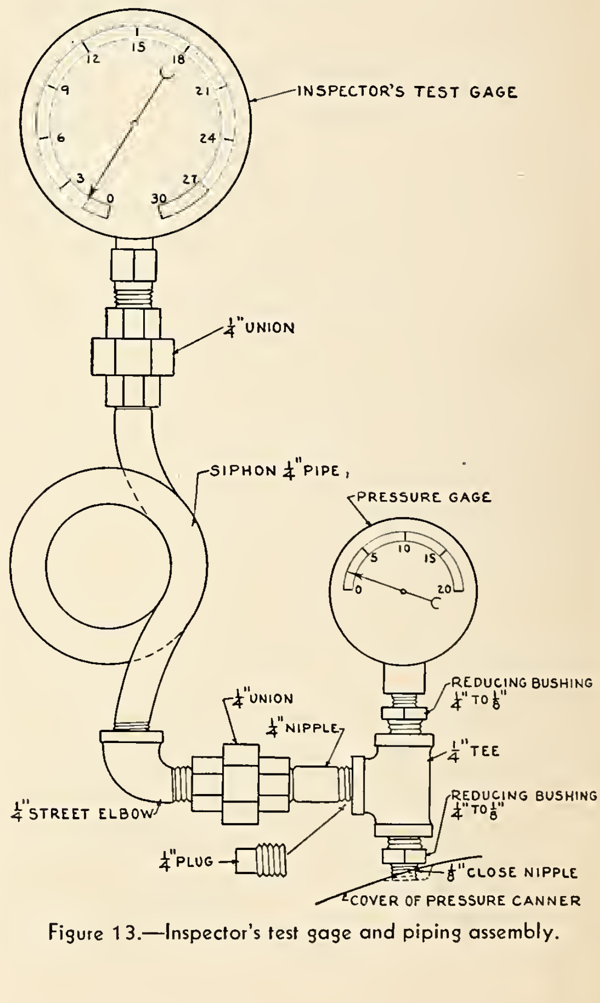

Figure 13.—Inspector's test gage and piping assembly.

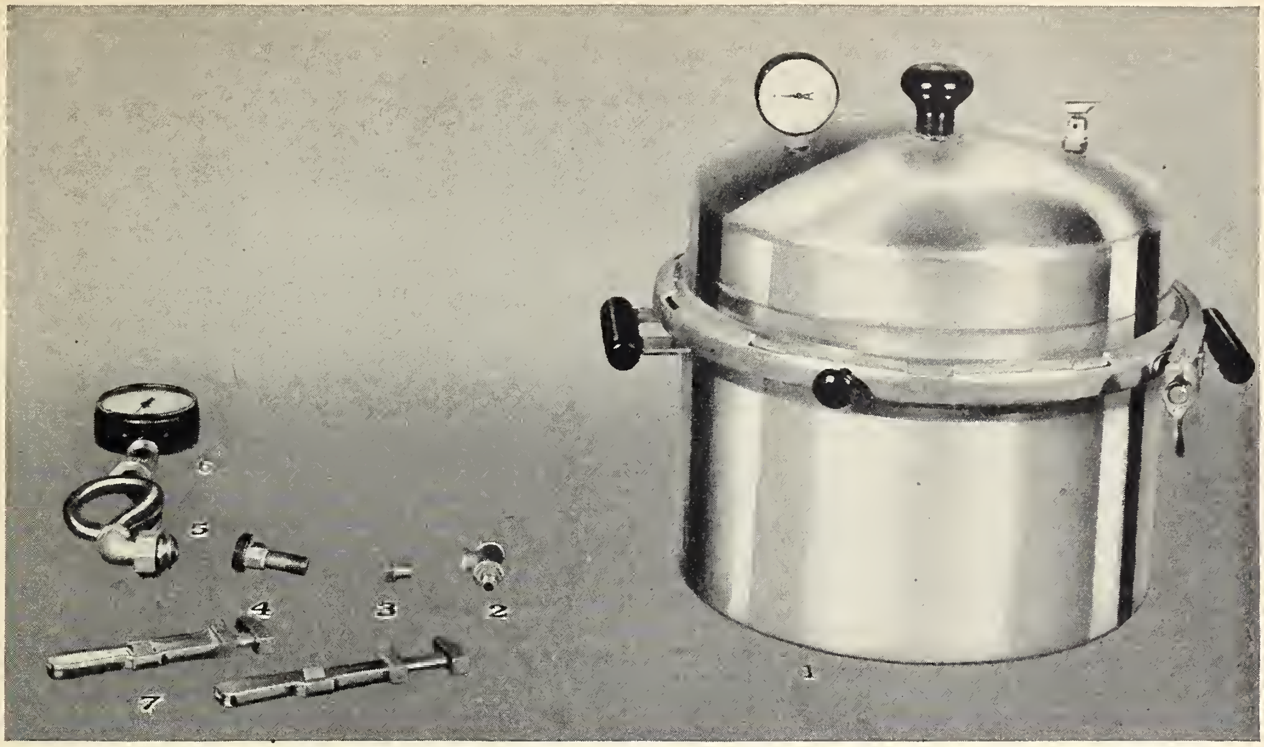

Figure 14.—Pressure canner and parts for gage tester: (1) Pressure canner with the pressure gage which is to be tested; (2) ¼-inch T reduced to ⅛ inch at top and bottom; (3) ¼-inch pipe plug; (4) ¼-inch pipe nipple with ¼-inch union connection; (5) ¼-inch siphon with ¼-inch union connections; (6) inspector's test gage with ¼-inch union connection; (7) 2 bicycle wrenches. (For details of parts listed above see figure 13.)

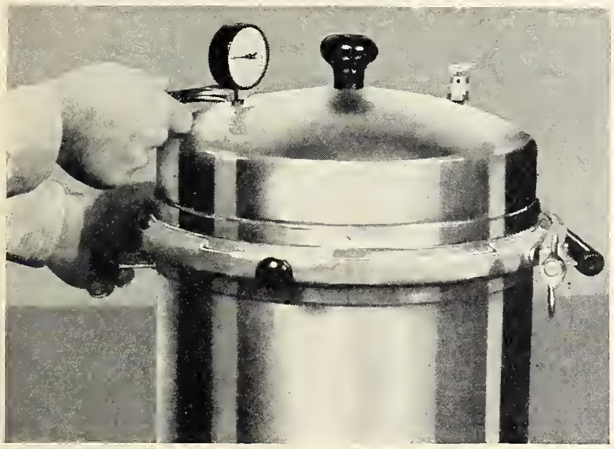

Figure 15.—Step 1, removing pressure gage.

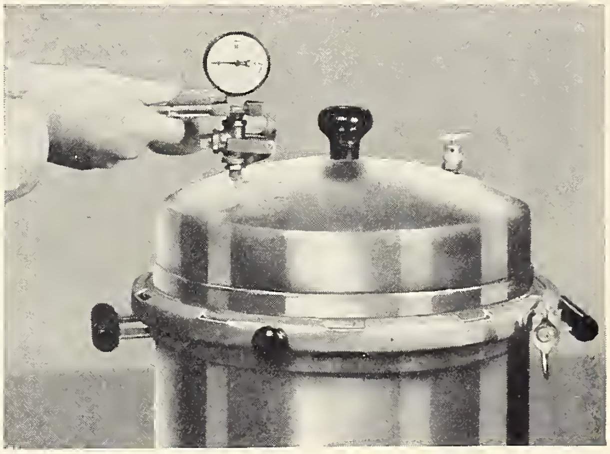

Figure 16.—Step 2, assembling gage tester.

Step 10: Screw the ¼-inch plug into the ¼-inch T on which the pressure gage is mounted. Support pressure gage with hand as plug is tightened with wrench.

The pressures shown by the canner gage when the test gage was at 10 pounds and 15 pounds per square inch are the pressures which the canner gage should show to give 10 pounds and 15 pounds, respectively, inside the canner. For example, if a canner gage registered 11 pounds when the test gage showed 10 pounds and 16 pounds when the test gage showed 15 pounds, that canner gage must read 11 and 16 pounds, respectively, in order to have 10 pounds and 15 pounds per square inch inside the canner. The readings of the canner gage which the test showed to give 10 pounds and 15 pounds within the canner should be recorded on a linen tag and the tag attached to the gage. Pressure gages which are in error more than 2 pounds should be replaced.


Figure 17.—Step 3, assembling gage tester.


Figure 19.—Step 5, assembling gage tester.


Figure 20.—Step 6, assembling gage tester.

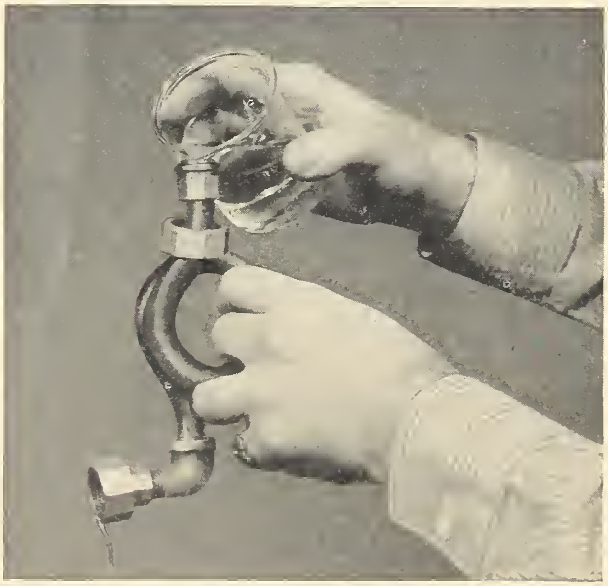
Figure 18.—Step 4, assembling gage tester.


Figure 21.—Step 7, testing pressure gage.

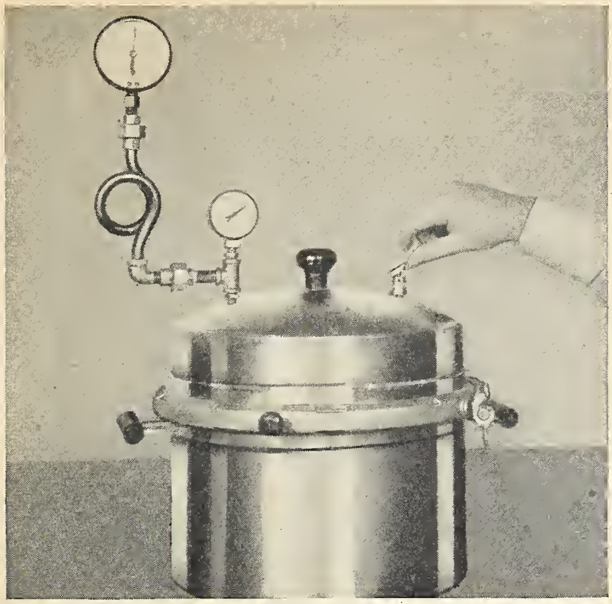

Figure 22.—Step 8, testing pressure gage.

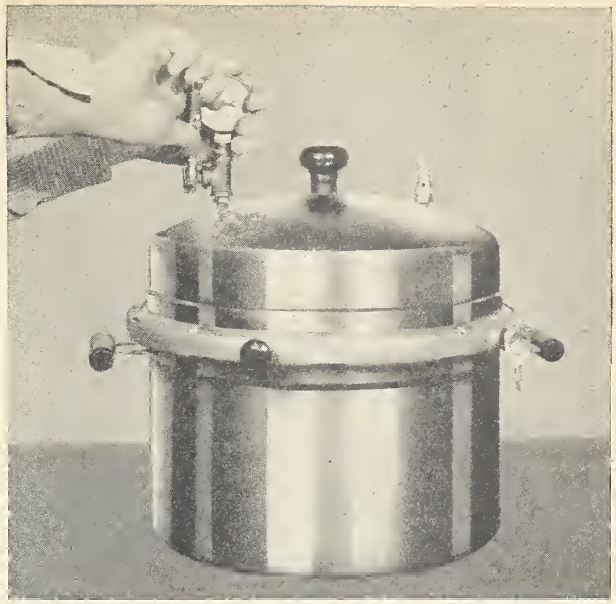

Figure 24.—Step 10, completing gage assembly on pressure vessel.

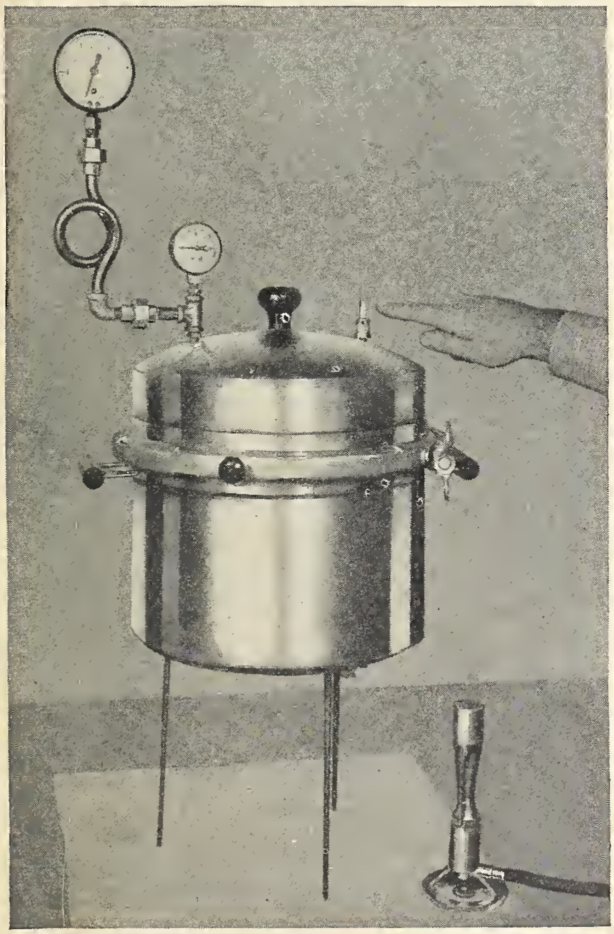

Figure 23.—Step 9, removing gage tester.

Figure 25.—Record and use of test results.

Open-process tanks

Although retorts may be used for processing acid products by the water-bath method, it is advisable to provide open-process tanks for this purpose. Greater flexibility in handling both acid and nonacid products during peak production periods is thus afforded. Each plant should have at least one open-process tank of the same size as the largest retort. By having them of the same size the inset crates of both vessels can be used interchangeably. At least two inset crates should be provided for each open-process tank. The tank, made of galvanized sheet metal, should be so constructed that the inset crate will rest on a perforated false bottom located slightly above the perforated steam pipe at the bottom of the tank. (See fig. 26.)

Such an arrangement permits the free circulation of water under the cans, necessary for the proper heat penetration, when processing. As with all open vessels fitted with standard-type pipe connections, steam is supplied to the open-process tank from the high-pressure line. A ½-inch line is adequate and may be connected to a perforated steam pipe as shown in the drawing or to a closed-coil system. An overflow pipe line should be provided at the top of the tank to keep the water at the proper level and to prevent spilling over that might otherwise occur when the water is at the rolling boil. The tank should be installed in line with the retorts and be properly centered so that the crates may be removed with the overhead hoist. It should be supported on a frame of the proper height to permit the installation of the steam pipe and drain. Water is supplied to the tank through a faucet or hose arrangement conveniently located near the tank.

Open-process tanks and retorts used for processing acid products should be filled with sufficient water to cover the cans. It is important that the water be boiling when the cans to be processed are added and that the timing of the water-bath process is not begun until the water has returned to the boiling point. In using steam-heated process tanks, care must be taken not to mistake the agitation caused by the steam for the actual boiling of the water. The water must be kept boiling throughout the processing period as any drop in temperature will cause the processing time given in this publication to be insufficient. The time for processing should be recorded on a pad or clock face specifically used for that tank. At the end of the the processing period the steam is turned off and the cans are removed for cooling.

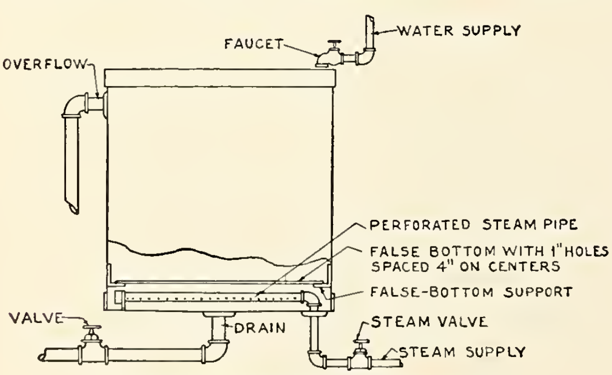

Figure 26.—Detail of open-process tank.

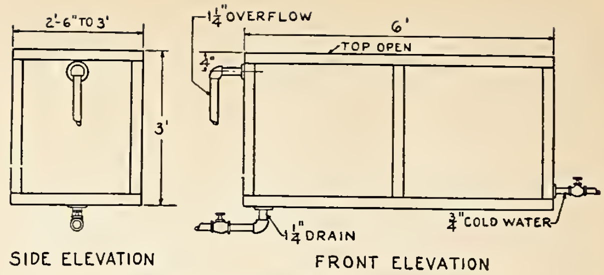

Figure 27.—Detail of cooling tank.

Cooling tank

To make the most efficient use of retorts a cooling tank should be provided for cooling products in cans of a size that do not require cooling under pressure. Metal cooling tanks are preferable because they are easy to keep clean and may be readily moved if necessary. Cooling-tank capacity should be sufficient to accommodate one crate for every three retorts or open-process tanks. The tank should be provided with a cold-water inlet at the bottom and an overflow pipe slightly above the height of the crate to carry the heated water to the drain. The overflow pipe should be placed at the opposite end from the inlet and should be sufficiently large to carry away the water displaced by the crate of cans when it is placed in the tank. The drain at the bottom of the tank should be of the same size as the overflow pipe. The cooling tank should be installed near the retorts and open-process tanks and directly under the overhead track and hoist so that crates of cans to be cooled may be conveniently handled. It should be mounted on a frame sufficiently high to permit the installation of a drain. The tank should be slightly elevated at the water-inlet end to facilitate drainage. (See fig. 27.)

The tank should be filled with cold water before the crate of cans is placed in it for cooling. Admit cold water to the cooling tank throughout the cooling period to assure the circulation of water necessary for rapid cooling. Remove the cans from the tank as soon as they are cooled to the proper temperature. (See p. 59.) The tank should be completely drained and thoroughly cleaned at the end of each day's operation and oftener if necessary.

Chain hoist and track

A differential geared-type chain hoist of ¼- to ½-ton capacity attached to an overhead track is necessary for lifting crates in and out of retorts, open-process tanks, and the cooling tank. (See fig. 28.) A hoist of ½-ton capacity should be used with the larger retorts in order

to provide the needed safety margin. The track should be centered directly over those vessels and should be extended over the areas where a hoist is needed to facilitate the handling of loaded crates. A heavy-duty garage-door track, hay track, I-beam, or a standard canner's rail and trolley may be used. The track should be installed high enough for the hoist to lift a basket clear of the vessels it is to serve. A similar hoist and track is recommended for those plants processing meats in order to facilitate the handling of carcasses.

Steam-jacketed kettles

One or more steam-jacketed kettles should be provided in each plant for rendering lard, making fruit butters and soup stock, and preheating such products as corn, apples, and pumpkin. They should be of stainless steel or aluminum to permit their use for any product. Kettles of 10- to 40-gallon capacity are most practical for use in community canneries. Either a stationary type, such as that shown in figure 29, or a tilting or trunnion type may be used. They should be located near the sealer since in most instances products heated in these kettles are filled directly into cans and sealed. They should be placed so that they are accessible from all sides. A pressure-reducing valve should be installed in the steam line leading to the kettle and should be set at the pressure recommended by the manufacturer of the vessel. A globe valve is provided between the pressure-reducing valve and the kettle for admitting steam to the kettle. In order to make the proper adjustment of the pressure-reducing valve and to know at all times the pressure of the steam that is being admitted to the kettle, a steam gage must be provided between the globe valve and the kettle. The pressure range of the gage should be such that it will measure the maximum operating pressure of the kettle.

A safety valve is usually provided on the kettle, as shown in figure 29. Where this provision has not been made, a safety valve must be installed in the steam line between the globe valve and the kettle. This valve should be set at a pressure slightly higher than that of the pressure-reducing valve and within the safety limits of the pressure at which the kettle can be operated.

Figure 29.—Stationary-type steam-jacketed kettle.

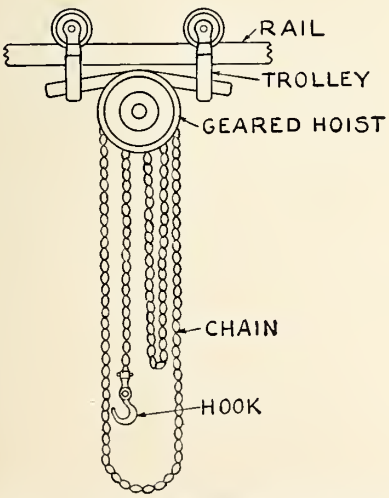

Figure 28.—Assembly of differential-geared hoist.

Steam-cooking coil

One or more steam-cooking coils, often referred to as brine tank coils, should be provided in a community cannery to supplement the steam-jacketed kettles. (See fig. 30.) They should be of a size to fit into a stockpot or kettle for preheating quantities of produce which are insufficient to warrant the use of a steam-jacketed kettle. They are convenient to use in that the inlet and outlet are over the side of the kettle and permanent attachments to the kettle are not required, thus making it easy to transfer them from one kettle to another. They should be supplied with

steam from a low-pressure line. It will be necessary to have a safety valve and a pressure gage between the pressure-reducing valve and the steam line leading to the cooking coils. In order to conserve the number of pressure-reducing valves required in the plant, this installation may be made in the low-pressure line leading to the steam-jacketed kettles.

For convenience in operation it is well to provide a low bench or table for the stockpots in which the cooking coils are used. An insulated mat should be provided under the kettle to protect the surface of the table or bench. Since these coils come in direct contact with the food and are usually made of copper tubing, they should be tinned. In some instances, particularly where large kettles are used, it may be desirable to have a coil with double loops in order to get more even heat throughout the product. By specifying the kind of produce to be heated, the size of the kettle to be used, the temperature to which the products are to be heated, and the amount of steam pressure available, manufacturers can determine the number of loops required in the coil and the type of coil that would be most satisfactory.

Sealers

A can sealer is a machine designed to form the double seam which attaches the cover to the can in such a manner as to effect a hermetic closure. Models vary widely in design, speed of operation, and a number of other details but they all have in common the following units essential in forming and rolling a double seam.

The *chuck* is machined to fit snugly into the recessed cover or countersink of the can and serves the dual purpose of steadying the can and acting as an anvil against which the seam is formed. In some machines the chuck is slightly knurled for traction which enables it to rotate the can.

The seaming rolls are divided into two classes according to their purposes. The *first-operation roll* has a groove which is semicircular and serves the purpose of turning the edge of the cover over the top flange of the can, thereby putting the cover hook and the can hook, as they are known, in proper position for sealing. The finished seam made by the first operation roll has a rounded contour. (See figs. 31 and 32.)

The *second-operation roll* is very similar to the first in that it bears the same relationship to the chuck, and that it is activated by the same force which may be either manually or automatically controlled. Its purpose is to smooth down or flatten the loosely formed layers of tin plate of the rounded seam made by the first-operation roll. For this purpose the seaming groove in the second-operation roll has a shallower and flatter groove contour than the first-operation roll. (See fig. 33.)

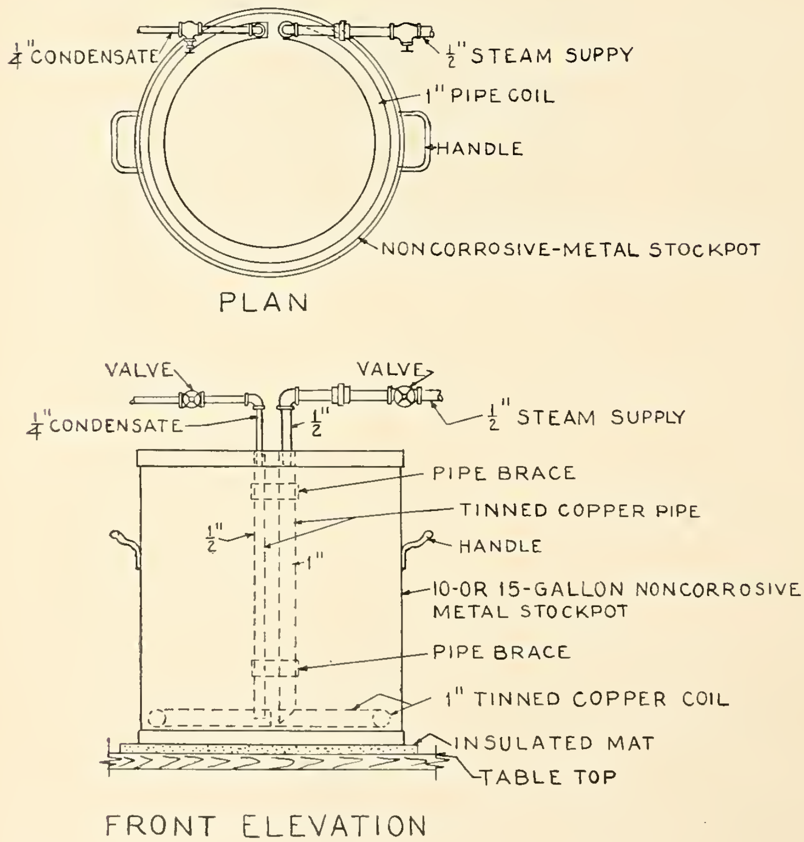

Figure 30.—Stockpot and steam cooking coil.

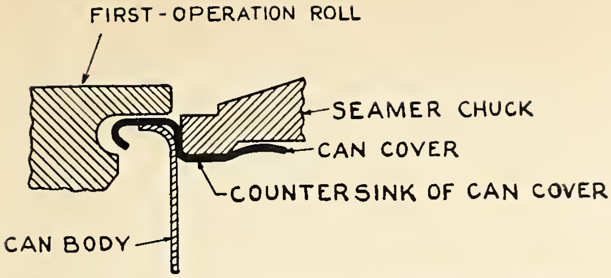

Figure 31.—Position of con and cover in relation to sealer part before seoming.

The *base plate* is a base or platform on which the can is supported during the seaming operation. In most machines it is free running and has no effect on driving the can, its only purpose being to give the can the proper pressure when it is raised into position.

Each of these parts is so machined that it may be adjusted to assure a perfect seam.

The size and number of sealers needed are determined by the anticipated daily output of the plant and the sizes of cans that are to be used. It is false economy to provide other than well-constructed sealers. Heavy-duty bench-type motor-driven sealers, such as shown

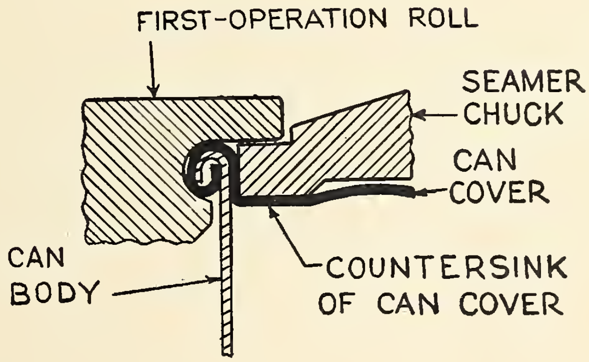

Figure 32.—Innermost position of first-operation roll in relation to chuck for forming first-operation seom.

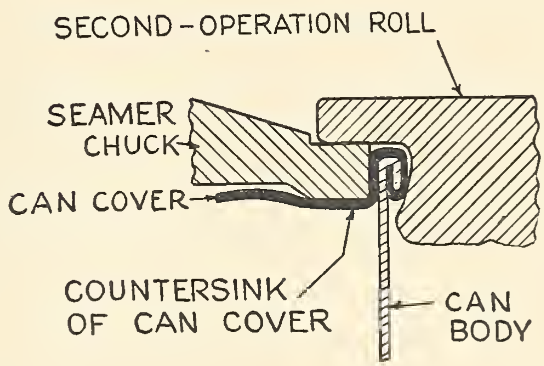

Figure 33.—Innermost position of second-operation roll in relotion to chuck for forming second-operation seam.

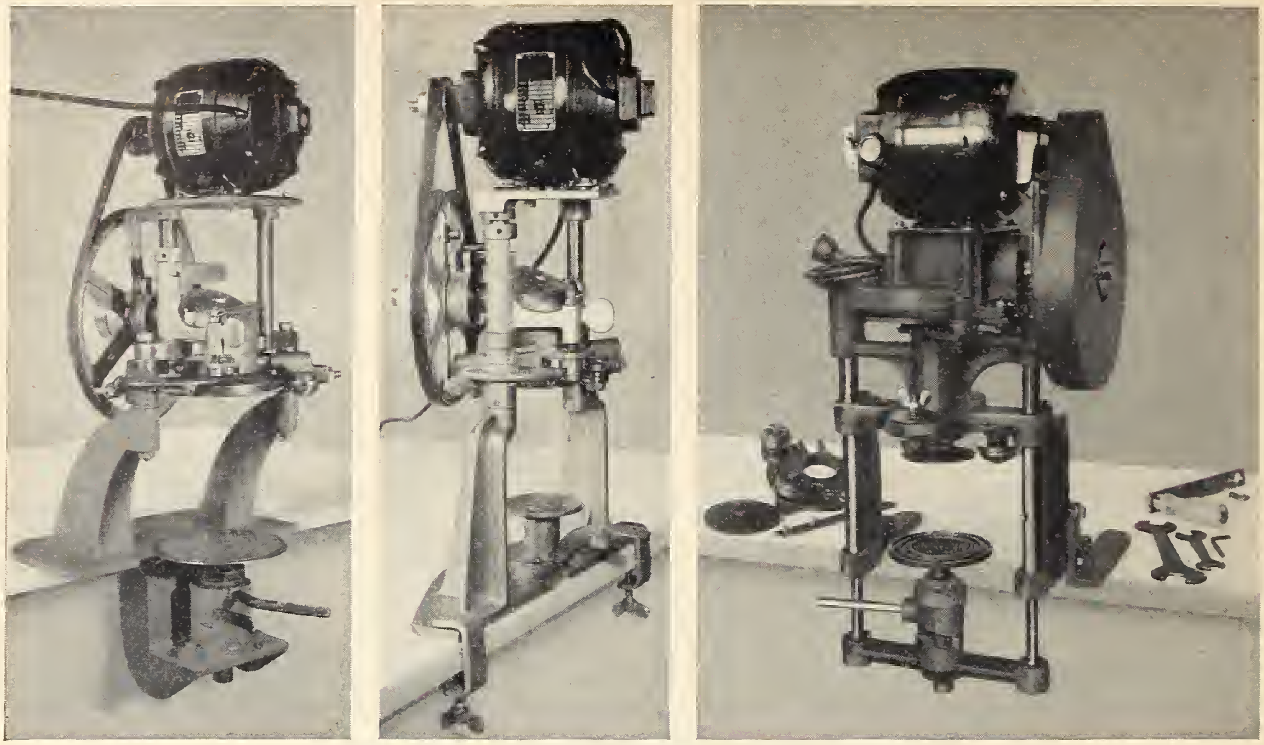

Figure 34.—Heavy-duty bench-type motor-driven sealers.

in figure 34, are recommended for use in community canneries. Such sealers are capable of sealing 5 or 6 cans per minute. At least 2 sealers of this type should be provided for plants having a capacity of from 1,000 to 2,000 cans per day. Plants having a capacity of from 2,000 to 3,000 cans per day should have 3 such sealers. Community canneries processing food in No. 10 cans for school-lunch purposes will require a heavy-duty sealer for sealing this size of can.

A bench-type motor-driven sealer is desirable for use in any size of plant. Hand-operated sealers may be used in very small plants but their limitations should be recognized. They are laborious to operate and even when operators are changed frequently, it is difficult to get capacity production from them. However, one or more hand-operated sealers should be provided in each plant for emergency use when the power is temporarily off or to replace motor-driven models that may have to be removed from service for repair or adjustment. Figure 35 illustrates a heavy-duty hand-operated sealer suitable for use in community canneries.

Can sealers should be located as near the exhaust box as possible, and they should be fastened securely to a sturdy table provided for that purpose. The table should be large enough to provide space for marking cans and should be of a height suitable for the type of sealer used. A table 34 inches high is needed for motor-driven sealers although a table 32 inches high is best for hand sealers. The table top should be of 2-inch lumber and should extend at least 2 inches from the frame of the table in order to provide space for securing the sealer.

Operation of sealers (double seamers)

The sealing of the can is the operation that safeguards its contents, and the success of the entire canning project depends on this step. The directions for operating and adjusting sealers given in this publication are based on those contained in a research report by Jarvis (*8*), of the United States Department

Figure 35.—Heavy-duty hand-operated sealer.

of the Interior, and on information contained in Baumgartner's Canned Foods (*3*).

Sealers should be operated in accordance with the manufacturer's instructions. They become worn by constant use and may get out of order, and their adjustment should be checked at least daily. This is best done at the beginning of the day by sealing several cans and examining the can seams. A careful visual examination of the contour of the double seam should be made first. Its outline should be free from sharp edges and it should not be beaded or rounded.

Rounded seams are usually the result of excessive rolling by the first-operation roll. In this instance, the strong curl that is formed resists the subsequent pressure of the second-operation roll. The top of the seam should be distinctly but not excessively flattened. Sharp edges at the top inside of the seam, known as "cut overs," are most frequently found on the cover where it coincides with the lock seam of the can body. They may be caused by a worn or chipped chuck, incorrectly set second-operation roll, or other maladjustments, and if cuts are deep enough to cut through the plate of the can, leakage may occur and spoilage result.

Spurs (or lips) may also cause leaker spoilage, and they are most frequently observed at the overlap, where the rolled seam coincides with the soldered side seam. They appear as protrusions at the base of the seam and usually result from failure of the seaming rolls to fold completely the cover hook under the can hook at one or more points. Among the causes of "spurring" the most common are: The first-operation roll being too tight; too much base plate pressure; maladjustment of rolls to the chuck; and irregular curl on can ends. There should not be any marked variation in the thickness of any given seam except for the normal increased thickness where the rolled seam coincides with the side seam. By comparing the seam made by the sealer with the factory-made seam of the can, noticeable differences can easily be detected.

Examination of the can seam

In order to confirm opinions formed as the result of the external examination of the can seam and to determine the sealer adjustment necessary to correct seaming operations, a section of the can seam should be stripped and examined. Leakage may occur from the defective engagement of the can and cover hooks. The lack of proper engagement may be due to one or both hooks being short or the hooks may be of normal length but not flattened tightly together. Figures 36 to 40, inclusive, illustrate the steps involved in filing a can seam in order to separate the hooks for examination and measurement. These steps are:

Step 1. With the edge of a flat file held at a 45-degree angle cut a notch completely through the double seam about 1 inch from the body seam. Examine the notch with a magnifying lens and note whether there are pin-point holes at the top of the seam or at the bottom. The absence of a pin-point hole or dark speck in the cross section of the seam at either of these points indicates that the base plate and the first-operation roll are properly adjusted. A noticeable pin-point hole near the bottom of the crosscut section indicates that the base plate pressure needs to be increased. A noticeable pin-point hole near the top of the crosscut section may indicate that the first-operation roll is too loose. A small hole at this point is of no importance. If the layers of tin are plainly visible in the crosscut section the second-operation roll is too loose.

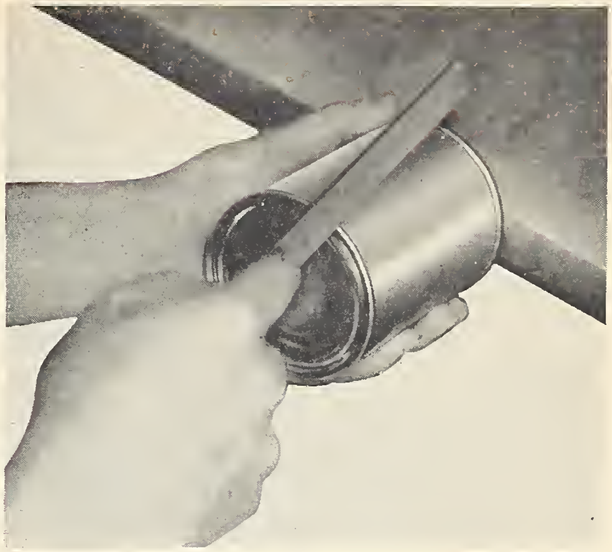

Figure 36.—Step 1, filing a can seam.

Step 2. Starting at the notch, file away the top outside edge of the double seam for a distance of 2 or 3 inches until the second layer of metal, "the can hook," is reached. Care must be taken to avoid filing into the top of the can hook. The area filed should extend beyond the body seam of the can. Hold the file at a 30-degree angle.

Step 3. Starting at the filed notch, tap sharply with the flat face of the file on the cut edge of the seam to disengage the cover hook and leave the can hook exposed. The tenacity with which the cover hook is held in place is an indication of the tightness of the seam.

Step 4. Bend cover hook up, as shown, for observation and measuring of both the can hook and the cover hook.

With a metal ruler, with a point ⅛-inch wide and less than 0.010-inch thick, measure the can hook, cover hook, and the countersink at several points. The

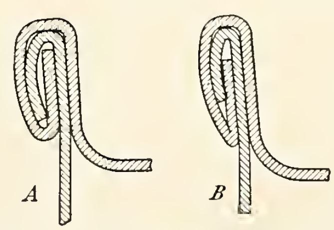

Figure 37.—A, Correct seam. B, Incorrect seam.

Figure 38.—Step 2, filing a can seam.

Figure 39.—Step 3, filing a can seam.

Figure 40.—Step 4, filing a can seam.

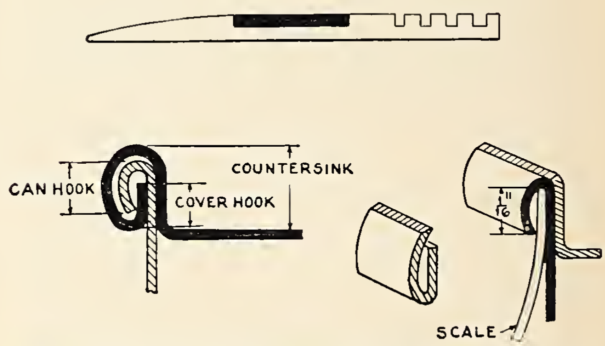

Figure 41.—Metal ruler and method of measuring can hook, cover hook, and countersink.

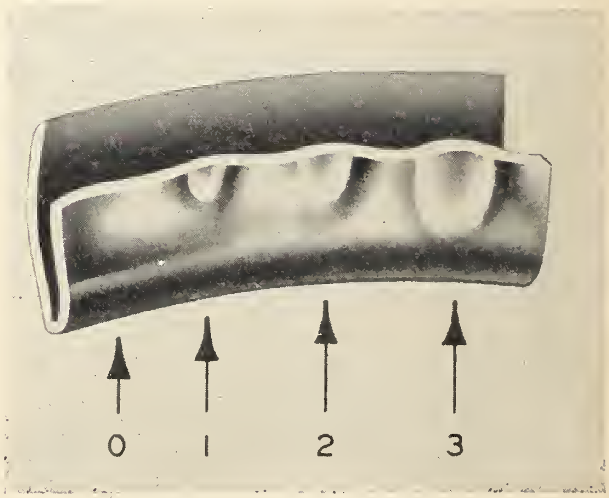

Figure 42.—Waves in cover hook.

length of the can hook should closely approximate that of the cover hook and should measure slightly over 1/16 inch. (See fig. 41.)

The hooks should be free from wrinkles or folds. These indicate seam looseness. On a properly flattened seam, all wrinkles should be ironed out fairly smooth by the second-operation roll. Figure 42 shows four degrees of wrinkles. A good seam will correspond to the 0 and 1 stages.

The countersink should be slightly over ⅛ inch in depth. A deeper countersink usually indicates that the chuck has been set too low in relation to the rolls. This may be responsible for short cover hooks. A shallow countersink may result from a worn chuck flange.

The chief cause of can-hook shortness is lack of base-plate pressure. It may also occur if there is too much clearance between seaming rolls and chuck. Another cause is short plate that results when body blanks are cut too narrow or when the body flange is uneven. It should be noted than the can hook at the overlap of the side seam is sometimes slightly short, the upper flap of metal being shorter than the under flap at their lower edges. It is equally important that hooks should not be too long. Excessive base-plate pressure, resulting in a long can hook, causes a corresponding decrease in the length of the cover hook and consequently affects the degree of engagement of the two hooks. It also induces "spur" formation.

When the cover hook is short, this is usually because of failure of the first-operation roll to tuck the cover far enough under the flange of the body. As it has to be bent round two thicknesses of metal at the side seam, the cover hook is invariably slightly short at this point. It seems highly probable that many cases of leakage in which mechanical defects are not obvious arise through this "normal" shortening of the hooks at the side-seam overlap.

To make sure than the seaming operations are uniform, it is well to inspect the seam occasionally around the entire circumference of the can. To do this, pull off the entire top of the can with a pair of pliers, starting at the point where it was originally filed, for checking a section of the seam. The entire cover hook and can hook may then be disengaged and further inspected.

Adjusting sealers

The test wire or gage provided with most bench-type sealers may be used for making the preliminary adjustments of the seaming rolls. Instructions for making these adjustments are provided with the sealer. The first-operation roll should be checked independently of the second-operation roll, and the machine should be manipulated by hand in each instance. The wire test on the first-operation roll should be made at the time the roll is at its innermost position. This is usually just before it is ready to recede. The chuck should be so alined that the top flange of the first-operation roll just slips over the edge of the chuck disk without rubbing. The chuck should turn freely and yet show no space between its upper edge and the roll flange. Depending on the type of sealer, adjust the chuck up or down or adjust the seaming rolls so that the chuck and seaming rolls are in perfect alinement. For correctly adjusted first-operation roll, see figure 43, and for correct first-operation seam, see figure 44.

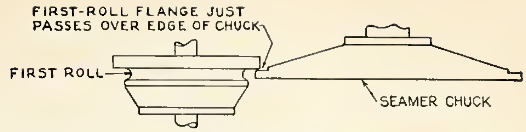

Figure 43.—Correctly adjusted first-operation roll.

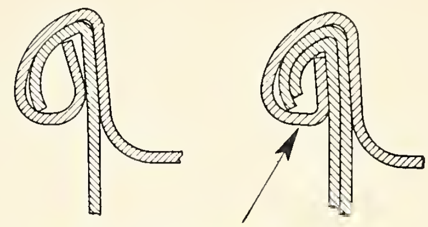

Figure 44.—Correct first-operation seam.

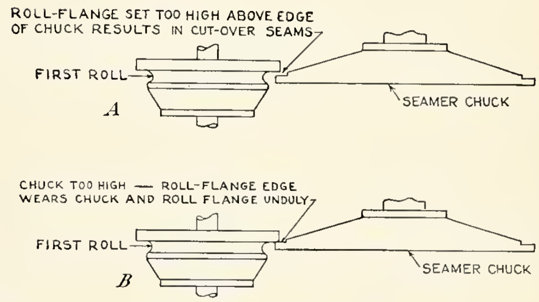

Figure 45.—Incorrectly adjusted first-operation roll: A, Roll-flange set too high; B, Chuck too high.

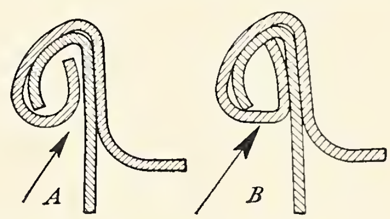

Figure 46.—First seam operation: A, Too loose; B, Too tight.

If the roll is set too high the can top will be rolled slightly over the edge of the chuck. If the chuck should be set too high the roll flanges will rub the edges of the chuck severely and in a short time the rolls and chuck will have to be replaced.

Figure 45 illustrates incorrectly adjusted first-operation roll.

Figure 46 illustrates first-operation seams that result when the first-operation roll is too tight or too loose.

In setting the first-operation roll for the proper distance of its groove from the chuck face, use the larger sized test wire provided for this purpose, inserting it between the roll groove and the chuck face. Set the roll so that a firm, steady pressure must be exerted to insert and withdraw the wire. Check the base-plate pressure by putting a can with cover in the machine

as for sealing. Adjust the base plate into position for sealing. While the can is still in position, run it through the sealer by hand to test the adjustments of the first-operation roll and the base plate. The metal of the cover should be tucked up closely against the can body, forming an almost round bead. It should not be so tightly rolled as to be almost solid or like a piece of wire.

If the first-operation roll is found satisfactory the second-operation roll may be set in seaming position. The procedure followed is practically the same as for the first-operation roll. The height of the chuck when set properly for the first roll should also be correct for the second roll. Turn the machine by hand until the second roll is at its closest point to the chuck. This occurs just before seaming is completed. Insert the smaller test wire between the roll groove and the chuck face, and adjust the second-operation roll until a firm, steady pressure must be exerted to insert and withdraw the wire. Repeat the test of putting an empty can with cover through the machine but in this instance complete the seaming process and carefully note the appearance of the seam. Do not depend entirely on the test wires for final adjustment but test the finished seam by the filing method previously described.

Exhaust boxes

An exhaust box is used for heating the contents of the can to the recommended center temperature for sealing. It must be so designed and constructed as to heat products evenly and in a minimum of time. Exhaust boxes heated with steam may be either tunnel-conveyor or batch-type. However, for economy and adaptability to handling varied products, a batch-type box, such as that illustrated in figure 47, is recommended for community canneries.

The steam is supplied from a high-pressure steam line. Water, filled into the box to a specified height, is heated by the steam passing through the closed pipes of the box. The pipe arrangement shown in figure 47 has proved an efficient means of getting even heat distribution throughout the box and is preferred to the U-coil arrangement sometimes used in community canneries. The spreader line at the end of the box where the steam is admitted is installed above the water line. Steam condensation is thus retarded and the heating efficiency of the steam is enhanced. A sloped arrangement of the pipes, leading to the condensation pick-up line outside the box, facilitates drainage of the condensate from the steam pipes.

The 3- by 4-foot box, shown in figure 47 will accommodate approximately 80 No. 3 cans. Two boxes of this size will exhaust sufficient products in 1 loading to fill 1 large retort or 4 small ones.

A batch-type exhaust box should be constructed of galvanized metal encased in wood, or provided with other insulation to protect workers. Such insulation will also prevent heat losses that would otherwise occur. To further prevent heat losses the box should be provided with a lid constructed so as to prevent condensate from dripping into the cans of produce. The lid, if hinged at the center, as shown in figure 47, may be easily lifted by a rope attached to a pulley overhead. A false bottom made of heavy-mesh wire should be provided in the box to allow for circulation of the water underneath the cans. A drain should be provided in the center bottom of the box and should be fitted with a removable overflow pipe to keep the water line approximately 2 inches below the tops of the cans. The end of the overflow pipe fitting into the drain should be so threaded that it may be adjusted up or down according to the size of the cans being used. This adjustment can be made easily by providing a handle on the top of the overflow pipe.

In order that patrons' produce may be kept separate it is recommended that can trays be used and properly identified with the patron's number. Several trays may be required for each patron's produce. In order that the cans may be heated in a minimum of time, the water in the box should be at the boiling temperature when the can trays are placed in the box. Naturally the temperature will drop somewhat at this time. After the water returns to a boil the globe valve, regulating the steam supply to the box, should be adjusted so that the water will not bubble over into the cans of produce. To assure the best quality of canned produce the exhausting period required for heating the cans to the recommended center-can closing temperature should be kept to a minimum. For fruits and vegetables canned in a liquid medium, this period should not exceed 10 minutes. Too-long exhausting periods will result in an overcooked product. If an exhaust box is incapable of producing the desired results, it should be corrected so that the canning procedure recommended can be followed. In no instance should canning procedures be adjusted to fit poor equipment.

Cans should be sealed promptly when the exhausting process is completed. Remove one tray at a time and only as it can be handled at the sealer. After the center-can temperature is reached, the water in the box should be kept at the simmering point until all trays of cans are removed for sealing.

The exhaust box must be drained, thoroughly cleaned, and flushed at the end of each day's operation. The lid should be adjusted in an open position so that the box will dry and be thoroughly aired before the next day's run.

Wash sinks

Double-compartment sinks 2 feet wide, 4 feet long, and 18 inches deep are adequate for washing produce. They should be of metal for convenience in keeping them clean. A sink should be provided at the end of each preparation table and should be supported on a frame high enough to bring the top of the sink level with the table top. Additional sinks will need to be provided near the preparation area, as shown in figure 2, so that a number of patrons can be accommodated at one time and bottlenecks in preparation

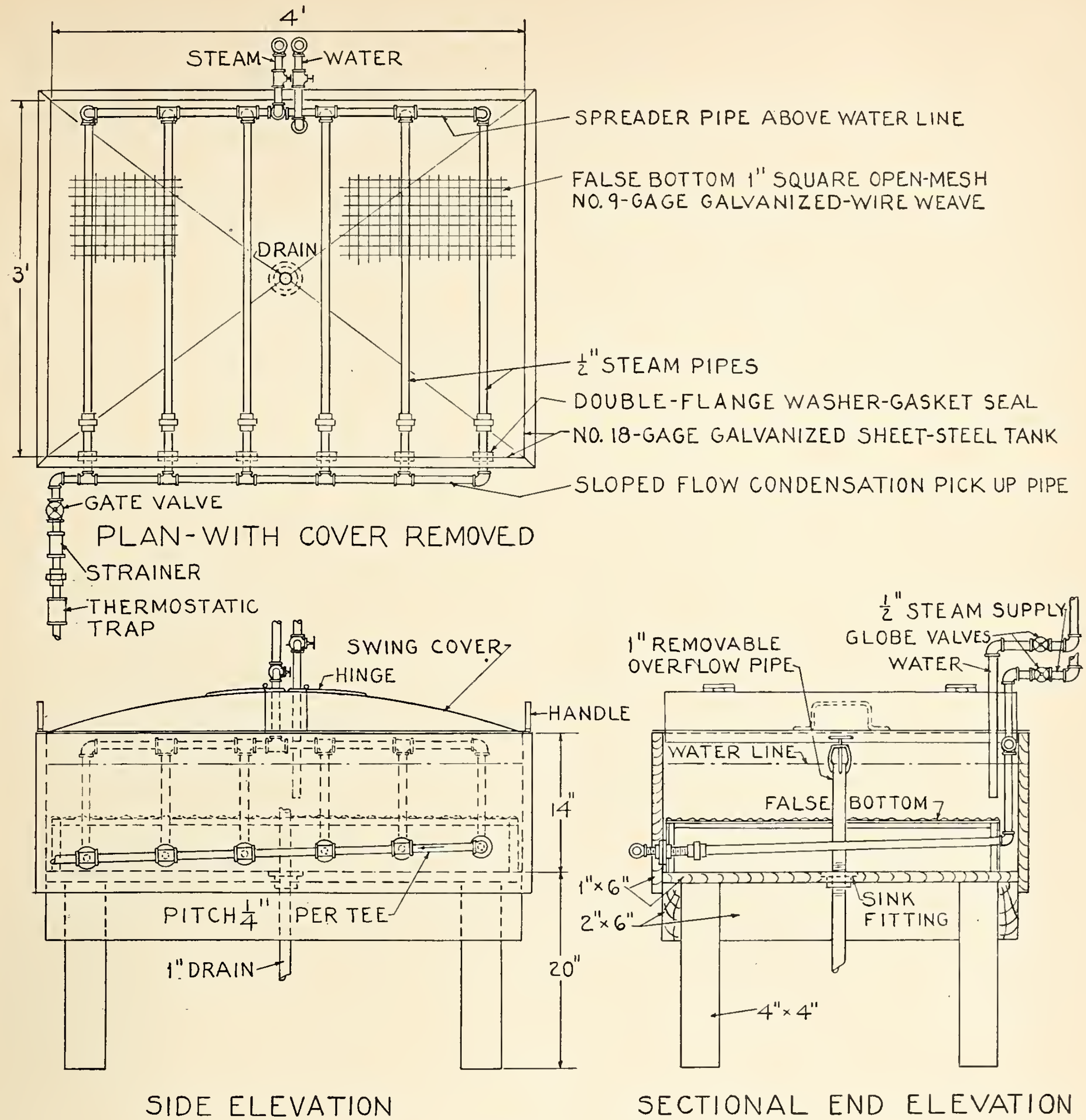

Figure 47.—Batch-type exhaust box.

activities avoided. One such sink will be needed for washing pots and pans. Additional wash sinks or a hose in the rough-preparation area will cut down the demands on the sinks in the cannery proper. When washing produce, it is well to handle it in small quantities in order to assure thorough cleansing. Water should be changed frequently. All wash sinks should have adequate drains protected with strainers to prevent clogging. At the end of the day the sinks should be thoroughly drained and cleaned to prevent rusting. Where large quantities of produce are to be handled, it may be well to purchase a rotary vegetable washer or to provide a large wash tank in the receiving area.

Blanch and scald tanks

Tanks of heavy galvanized metal, equipped with drains and closed-coil steam pipes for heating water, are essential for scalding and blanching operations. (See fig. 48.)

One tank should be provided at the end of each fill table adjacent to the cold-dip tank. It should be

supported on a frame sufficiently high to bring the top of the tank in line with the top of the fill table and supplied with steam from the high-pressure line. Tanks 22 inches square and 22 inches deep are adequate for blanching or scalding operations. A tank of this size is large enough to permit the introduction of the produce into the tank without changing the temperature of the water more than a few degrees. Blanch and scald tanks are used interchangeably, depending on the needs. Water used for blanching and scalding should be changed as often as is necessary to keep it clean and to avoid recontamination from the bacteria removed in the process. The tanks should be thoroughly drained and flushed at the end of each day's operation. In those plants which process quantity lots of such produce as sweetpotatoes, peaches, and grapefruit it is well to provide a similar tank arrangement for lye-bath peeling. This tank should be convenient to the preparation tables.

Cold-dip tanks

A cold-dip tank of the same size and height as the blanch or scald tank should be installed adjacent to it at the end of each fill table. The cold-dip tank should be of galvanized metal and be equipped with a drain and a cold-water inlet. The water should be changed as often as necessary to keep it clean and cold. At the end of each day's operation the tanks should be drained, thoroughly washed, and steamed.

Tanks for the medium

A 15- to 25-gallon tank should be provided on each fill table, adjacent to the exhaust box, for the medium used in the cans of produce. Because the tank is used for brines as well as for sirups and water, it should be of noncorrosive metal. The tank should be supported on a frame sufficiently high to accommodate the tallest can under the spigot arrangement leading off from the bottom of the tank. (See fig. 49.)

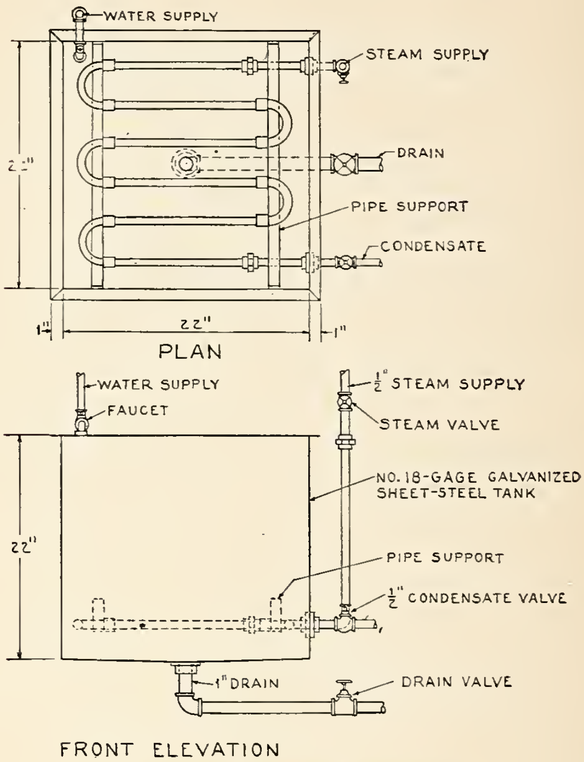

Figure 48.—Blanch or scald tank.

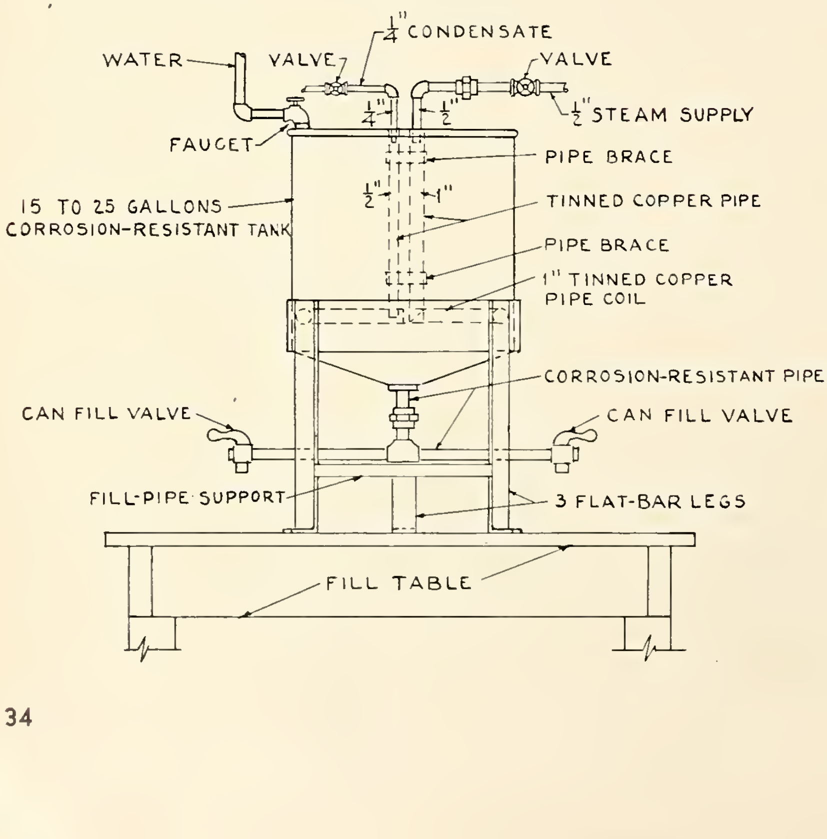

Figure 49.—Medium tank and steam coil.

The tank is heated by a steam coil such as is used in precooking foods in stockpots. It is supplied with steam from a low-pressure line. At the end of each day the tank should be emptied and thoroughly cleaned to avoid contamination and rusting. It should be rinsed with cold water before using.

Preparation and fill tables

Standard-sized tables, 4 feet wide, 10 feet long, and 34 inches high, should be provided for the preparation of the produce and the filling of the cans. (See fig. 50.)

A table of this size accommodates four persons at each side and is wide enough to permit the use of two preparation pans by each person. It is recommended that the table top be made of rough lumber covered with galvanized sheet steel. A rolled-edge around the sides of the table will help to keep the preparation area sanitary. Table tops may also be finished with masonite, or waterproofed plywood, or they may be made of tongue-and-groove flooring painted with a good grade of enamel or deck paint. Unpainted wooden table tops are difficult to keep clean and are therefore not recommended. Linoleum table tops may be used but they do not stand up under the treatment necessary to keep the table tops clean.

Meat-cutting tables

In those rural areas where a considerable amount of meat is canned it may be advisable to provide meat-cutting tables. However, hardwood meat boards placed on top of the preparation or fill tables are satisfactory for cutting and boning meat. It is best to have meat tables 32 inches high as this gives a good working leverage in handling and cutting meat. They should be 4 feet wide and from 6 to 10 feet long. They will need to be sturdily built. The top should be made of 2- by 4-inch hardwood. In order to assure a smooth surface free from cracks, it should be bolted at several points along the length of the table. The bolts should extend through the boards the entire width of the table. The bolts may be threaded on one or both ends and fitted with nuts and washers so that the table top may be tightened. The top may be made so that it can be reversed on the table frame. It need not be attached to the frame as the weight of the top is sufficient to hold it in place.

Other equipment

Cutting boards

Cutting boards of hardwood are needed for general use. They will conserve table tops and aid in handling produce in a sanitary manner.

Blanching baskets

Blanching baskets, approximately 16 inches in diameter and 18 inches deep, such as those illustrated in figure 51, should be provided for blanching or scalding

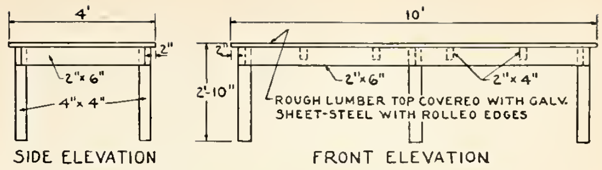

Figure 50.—Detail of preparation or fill table.

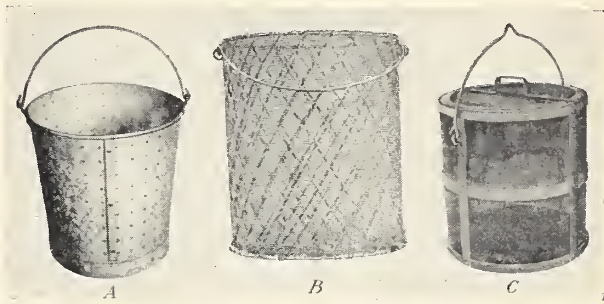

Figure 51.—Blanching baskets: (A), Perforated galvanized-metal bucket; (B), galvanized hardware-cloth basket; (C), galvanized hardware-cloth basket.

produce. Galvanized wire potato-picking baskets of one-half-bushel capacity and lined with No. 6 mesh hardware cloth also make excellent baskets.

Can trays

Trays made of wire are indispensable for carrying cans to the wash tank, fill table, and exhaust box and for keeping patrons' cans separated in the exhaust box. For ease in handling, trays should be only large enough to hold from 15 to 18 No. 3 cans.

Canning thermometers

Mercury-filled canning thermometers in metal carrying cases, with temperature ranges of 0° to 220° F., are needed for checking center-can temperatures. (See fig. 52.) Every canning unit should have a minimum of two thermometers and two additional graduated glass tubes for replacements.

Dishpans

Dishpans made of aluminum, tin, or enamel, of 12- to 16-quart size, should be provided for preparation of produce. The number of dishpans needed will be determined by the number of patrons that can be accommodated at preparation tables. An average of two dishpans should be allowed for each patron.

Figure 52.—Canning thermometer and metal carrying case.

Cutlery

Although most community canneries require that patrons provide their own cutlery for the preparation of produce, it is recommended that canneries purchase such equipment in order to standardize the type and size best suited for their use. All cutlery should be of high-quality carbon steel of an approved design. Unpainted handles are preferred. Blades should be riveted to handles. Sharpening steels should be equipped with guards. Stainless-steel kitchen cutlery is not desirable since it does not retain a sharp edge under canning conditions. Accidents are reduced to a minimum when the proper cutting tool is used. Figure 53 illustrates cutlery of good design for the preparation of fruits, vegetables, and meats.

Figure 53.—Cutlery: 1, Skinning knife, 6-inch blade; 2, scimitar steak knife, 10-inch blade; 3, scimitar boning knife, 6-inch blade; 4, butcher knife, 6- to 12-inch blade; 5, paring knife or chicken knife, 3½-inch blade; 6, knee-action vegetable peeler; 7, tomato-peeling knife; 8, pear-coring hook; 9, peeling and coring knife; 10, fine-cut knife steel, 10 to 12 inches long; 11, meat saw, ½-inch blade, 18 to 22 inches long.

Can-seam-inspection equipment

Mill files of 10-inch length should be made available in canning units, for use in filing can seams. A small magnifying lens should also be provided for inspecting the seam. A metal ruler with a point ⅛-inch wide and less than 0.010-inch thick is needed for measuring the can hook, cover hook, and countersink. Metal files are usually available from can companies.

Can-straightening device

A can-straightening device should be provided in every cannery in order that those cans that have become misshapen or damaged in shipment may be straightened and used. Badly damaged cans should be discarded. This is particularly true where the soldered side seam has been damaged. Can-straightening devices are available from most suppliers of canning equipment.

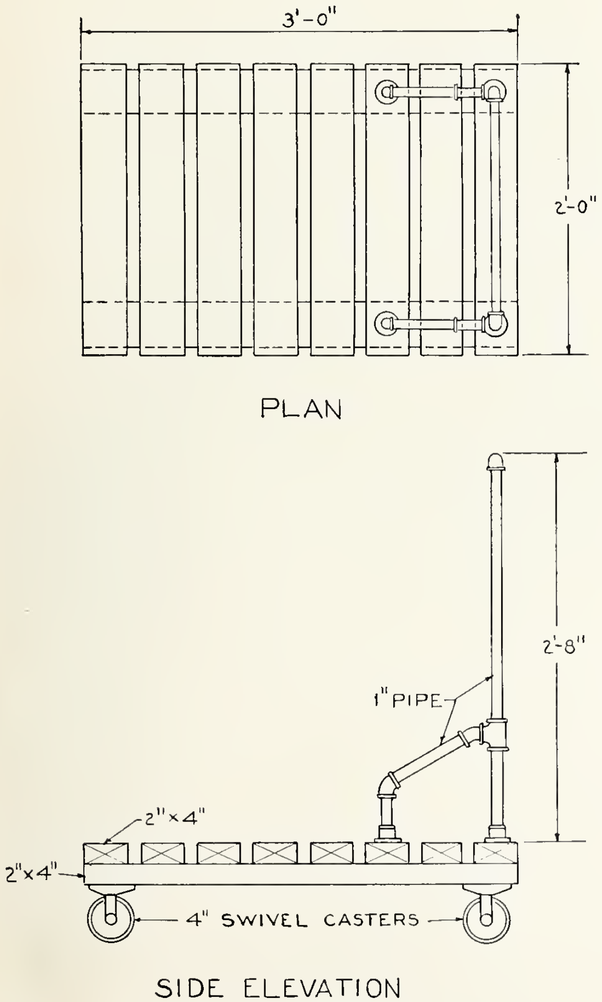

Figure 54.—Utility truck.

Gloves

Rubber-covered canvas gloves are needed for handling hot cans at the sealer and for loading cans into retort crates. They should be loose fitting at the wrist so that they can be removed quickly in case of emergency. The use of gloves saves much time in handling hot containers. However, employees and patrons should be cautioned that continual use of gloves may cause hands to become tender and susceptible to infection.

Utility trucks

Utility trucks are necessary for moving produce, cans, and equipment. They may be of metal or wood and should have ball-bearing wheels to facilitate the movement of heavy loads. The frame should be substantial enough to support a retort crate filled with cans. (See fig. 54.)

Garbage cans

Enough refuse and trash containers should be provided to give sufficient capacity for at least 1 day's accumulation of refuse. These should be of metal with close-fitting covers and should be watertight. Galvanized buckets are needed for general use, such as carrying out garbage.

Steam and water hose

Steam hose should be provided near the equipment that needs to be cleaned by steam. Steam hose may also be used for heating water. Water hose is needed for cleaning floors, tables, and similar equipment.

Fire extinguishers

If wood or coal is used as fuel and no oil, gas, or gasoline is used in the building, a soda-acid type of extinguisher will be adequate, or if a reliable source of water is available, a suitable pump or hose will be sufficient. If oil or gas is used as fuel, two or more 15-pound Dugas dry-powder-type hand fire extinguishers should be installed in addition to the water extinguishers. Installation of any safety device should be checked by a safety engineer.

Tools for adjusting and repairing equipment

Tools for adjusting and repairing equipment should be kept in a definite place so they may be readily available when needed. Loss of tools may mean loss of production hours. Tools required for adjusting and repairing equipment should include:

1 hammer
1 saw
1 square
1 pipe vise
2 18-inch pipe wrenches
1 set of bicycle wrenches
1 set of pipe-threading equipment
1 6-inch screw driver
1 12-inch screw driver
1 hack saw and blades

Replacement parts

A supply of extra parts should be kept on hand at the cannery to replace or repair those parts that may break or wear out quickly under constant use. This will avoid delay in operation. The following items should be the minimum kept in stock:

For retorts

Wing nuts, 1 extra for each retort.
Eye bolts, 1 extra for each retort.
Gaskets, 1 extra for each 2 retorts of same size.
Pressure gage, 1 extra for each 3 retorts.
Safety valve, 1 extra.
Thermometer, 1 extra.

For pressure canners

Wing nuts, 1 extra for each canner used.
Gasket, 1 extra for each canner.
Safety valve, 1 extra.
Pressure gage, 1 extra for each 5 canners.
Safety plug, 1 extra.

For sealers

Seaming rolls, 1 set for each sealer.
Sealer arms, 1 set.
Adjusting screws, springs, and hand washers or rubber pads as required for base plates.

Other items needed will depend on the type of sealer used. Sealers should be given periodic inspection for worn parts.

For boilers

2 water-gage glasses and packing washers.
2 sets of hand plate gaskets.
1 fusible plug.

For plumbing

Valve seats for all types of replaceable seat valves.
Pipe-thread compound.
Thread-cutting oil.

Cleaning equipment

Cleaning equipment, consisting of brooms, mops, squeegees, scrub brushes, and cleaning cloths, should be provided. Such items should be kept together in a storeroom provided for that purpose.

Containers Generally Used

Size of cans

The number of can sizes used in a community cannery should be limited because the processing time differs for the various sizes and because the time involved in changing the sealer may delay the canning operation. Sizes most commonly used for community and school-lunch or institution canning are given in figure 55 and in table 2.

TABLE 2.—*Size and description of cans commonly used*

Size of can	Dimensions		Factory symbols	Volume of cans	Average net weight
	Diameter	Height			
	Inches	*Inches*		*Cups*	*Ounces*
No. 2	3 7/16	4 9/16	307 x 409	2½	20
No. 2½	4 1/16	4 11/16	401 x 411	3½	28
No. 3	4 4/16	4 14/16	404 x 414	4	38
No. 10	6 3/16	7	603 x 700	13	110

Type of finish

Three types of finish in containers generally used for canning are: Plain tin; C-enamel; and R-enamel, also called Standard enamel. Enameled cans are not necessary to insure a wholesome product but are used to prevent discoloration which occurs with some products when plain tin is used. C-enamel cans are used to prevent discoloration of nonacid products containing sulfur. R-enamel cans are used to prevent the loss of color which occurs when highly colored fruits and beets are placed in plain tin.

Table 3 gives the recommended types of container most satisfactory for various products.

TABLE 3.—*Recommended type of container for specified products*

Product	First choice	Second choice
Apples	Plain	
Apricots	do	
Asparagus	do	
Beans, green and wax	do	
Beans, green lima	C-enamel	Plain.
Beets	R-enamel	
Berries	do	
Carrots	Plain	
Cherries, sour	R-enamel	Plain.
Cherries, sweet	Plain	
Corn	C-enamel	
Fruit juices	R-enamel	
Grapefruit	Plain	
Meats	do	
Mixed vegetables	do	
Okra	do	
Peaches	do	
Pears	do	
Peas	do	
Pineapple	do	
Plums	R-enamel	
Pumpkin or squash	do	
Sauerkraut	do	Plain.
Summer squash	Plain	
Sweetpotatoes	do	
Tomatoes	do	

Purchase of cans

When a large production is expected and space is available for storage it is desirable from a standpoint of expense and convenience to purchase the season's supply of cans at one time. A carlot of No. 2 cans contains from 50,000 to 97,000 cans, and of No. 3 cans from 36,000 to 50,000, depending on the length of the car. Cans should be shipped in bags or cartons to minimize damage in shipment and storage and to keep cans clean until they are used.

Table 4 gives the approximate number of cans required for a measured quantity of some of the more common fruits and vegetables.

TABLE 4.—*Approximate number of cans required for measured quantities of produce*

Product	Weight per bushel	No. 2 cans required	No. 3 cans required	No. 10 cans required
	Pounds	*Number*	*Number*	*Number*
Apples	50	30	20	6
Beans, lima (in shell)	28	10	8	3
Beans, green and wax	24	21	16	4
Beets (without tops)	60	32	24	7
Berries	[1] 40	24	18	6
Carrots	50	30	20	6
Cherries	56	34	25	7
Corn (green, sweet)	35	[2] 12	-----	-----
Greens	12	10	7	2
Peaches	50	30	20	5
Peas (green, in shell)	30	32	24	3
Plums	60	45	30	9
Squash	40	30	20	6
Sweetpotatoes (fresh harvest)	52	30	20	6
Tomatoes	56	22	15	5

[1] 24-quart crate.
[2] Whole grain.

Small canning centers operated with gas burners

In those sections of the country where gas is available at low cost, communities planning to set up small centers may find it advantageous to use gas burners to heat the various pieces of equipment needed to process foods. In planning this type of unit it is well to consider its disadvantages as well as its advantages. Chief among these disadvantages is the lack of a central source of heat to furnish adequate supplies of steam and hot water. Furthermore, the heat generated by the numerous burners required for heating individual vessels presents ventilation problems in that the atmosphere in the room becomes most un-

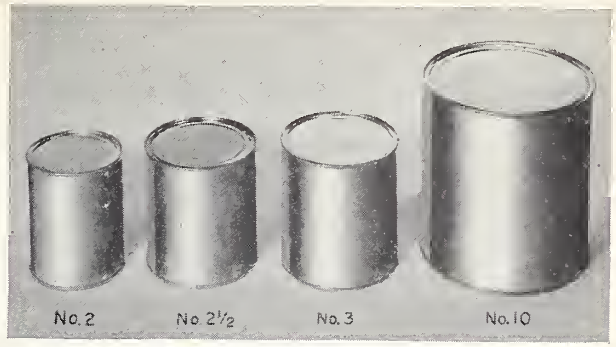

Figure 55.—Relative can sizes.

comfortable unless adequate means of ventilation are provided. It is recognized that this type of plant is less costly to install than a similar-sized plant set up to operate with steam generated from a gas-fired boiler.

Before deciding on the type of plant to be set up it is recommended that local authorities governing the installation of gas equipment be consulted because, in many municipalities, there are regulations which must be complied with. The advice of the local gas company should also be sought before selecting gas appliances since they generally can supply the names of high grade manufacturers of national reputation who are in a position to furnish equipment that is properly designed and engineered. The local gas company can also furnish the necessary information which the manufacturers would need in order to supply a burner most suitable for the gas in the particular locality and advise on safety precautions. The same careful planning will need to be exercised in selecting the site and building for the multiple burner units as for steam-operated units. In addition, special consideration must be given to ventilation, as stated

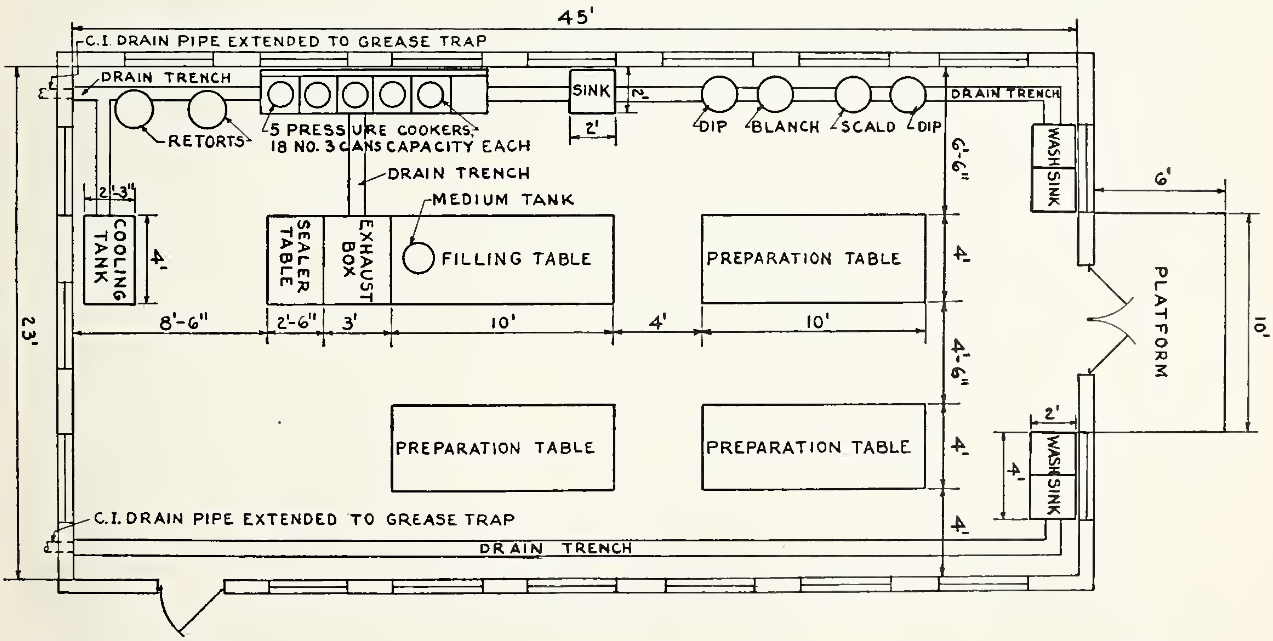

Figure 56.—Plan of community canning plant, using gas service, with daily capacity of 500 to 800 No. 3 cans.

above, in order to avoid overheating of the plant and the accumulation of moisture and the products generated by the fuel. Figure 56 illustrates the placement of the major items of equipment in a multiple-burner plant with a daily capacity of 500 to 800 cans. It is not considered feasible to operate a plant of greater capacity without a boiler as a central source of steam.

A list of the equipment required for a multiple gas burner plant similar to the one illustrated is given in table 5.

The blanch and scald tanks, the medium tank, and the exhaust box should be of a size for efficient operation of the plant. The burners for these tanks and the box as well as for the retorts and pressure canners should be of a size and type to generate sufficient heat to bring the vessel up to operating temperature within the time required for efficient plant operation and to assure products of good quality. This is well illustrated in the case of the blanch or scald tank. To heat these vessels the burner must be of sufficient capacity to assure quick recovery of boiling temperatures required for scalding and blanching the produce. Unless this is provided, much time will be lost in waiting for the water to return to a boil and the produce will be partially cooked in the process. In the case of the medium tank a smaller burner may be used as it is only necessary to keep the brine or sirup at a boiling temperature. Any change made in the details of the drawings in the illustrations may change the burner requirements.

For those vessels heated with an open-flame gas burner it is essential that a skirt be provided around the base of the vessel to screen the flame from air drafts and to prevent injury to workers. It is also necessary when heating with gas burners to provide proper-sized flues or outlets to the outer air to assure the full efficiency of the burners and to carry away the products of combustion. Such flues should be equipped with a suitable draft diverter and should extend vertically from the appliance and exhaust the products either under a properly ventilated hood into a chimney or in an approved manner through the roof. The size of the flue varies with the size of the burner. The area of the flue should be at least 1 square inch for each 7,500 B. t. u. of burner capacity.

TABLE 5.—*Canning equipment required for multiple gas burner plant of 500 to 800 No. 3 can capacity per 8-hour day*

Item	Description	Number required	Item	Description	Number required
Gas burner	85,000 B. t. u./hr. wheel-type for heating 33 can capacity retorts.	2	Wash sink	2′ x 2′ x 18″ (for washing utensils).	1
Gas burner	107,000 B. t. u./hr. wheel-type for heating 20″ x 18″ galvanized blanch and scald tank.	2	Wash sink	4′ x 2′ x 18″ double-compartment (for washing produce).	2
			Scald and blanch tank.	18″ diameter x 20″ deep	2
Gas burner	40,000 B. t. u./hr. ring-type for heating 17″ x 15″ medium tank.	1	Cold-dip tank	18″ diameter x 20″ deep	2
			Medium tank	15″ diameter x 17″ deep for brine, sirup, etc. (approximately 10-gallon capacity).	1
Gas burner	30,000 B. t. u./hr. ring-type for heating 14 to 18 qt. pressure canners.	4 or 5	Cooling tank	4′ x 3′ x 2′ (mounted at working height).	1
Gas burner	125,000 B. t. u./hr. immersion-type for heating 3′ x 4′ batch-type exhaust box.	1	Preparation table	10′ x 4′ x 34″	3
			Fill table	10′ x 4′ x 34″	1
			Sealer table	30″ x 4′ x 32″ (for hand-operated sealer).	1
Retort with inset crate.	33 No. 3 can capacity	2	Sealer table	30″ x 4′ x 34″ (for bench-type motor-driven sealer).	1
Pressure canner with inset rack.	14 to 18 No. 3 can capacity	4 or 5			
Open-process tank	Wash boiler heated over pressure-canner burners (blanch or scald tanks or retorts may also be used).	(1)	Blanching basket	Wire mesh	6
			Can tray	18 No. 3 can capacity	24
			Cutting board	Hardwood 18″ x 12″	(2)
			Dishpan	12 to 16 quart	(3)
Stockpot	Heavy galvanized metal, 5 to 10 gallon size for precooking of products such as corn, applesauce, etc.	2 to 4	Thermometer	Canning	2
			Gage tester	For testing pressure gages	1
			Can lifter	For lifting cans from exhaust box.	2
Sealer	Bench-type, motor-driven, 5 or 6 cans per minute.	1	Gloves	For handling cans at sealer	(4)
			Mill file	10″ for filing can seams	6
Sealer	Bench-type, heavy-duty, hand-operated, 3 or 4 cans per minute.	1	Magnifying lens	Small, for inspecting can seams.	1
			Metal ruler	Standard, for measuring body and cover hook of can seam.	1 or 2
Exhaust box	3′ x 4′ x 15″ batch-type (covered).	1			
			Garbage can	20-gallon capacity with cover.	2 or 3

(1) One or more. (2) Optional. (3) Eighteen or more. (4) Six pair.

NOTE.—Other equipment needed will include fire extinguisher, marking equipment for cans, repair parts for equipment, tools for making repairs, and special equipment, such as sieves, meat grinder, small pea sheller, and small bean cutter. Paring knives, tomato-peeling knives, vegetable knives, and butcher knives should be provided by the cannery to standardize the types and sizes desirable. For suppliers of equipment for gas-burner units, see Partial List of Manufacturers, page 83.

Flue requirements in particular should be reviewed with the authorities governing installation of equipment, as this is one point on which almost every municipality has regulations. All flues should be insulated to a height of 6 feet to protect the workers from coming in contact with the hot pipes. All floor, table, and wall surfaces exposed to the heat of the gas burners should be well insulated with noncombustible material to prevent fires. When gas burners are installed a space of 3 to 6 inches should be left between the vessel and the burner to assure efficient heating. This will vary according to the characteristics of the gas. A competent gasman should be able to determine the proper height.

Installation drawings are shown of only those vessels which are heated with gas burners. Other items of equipment required, such as preparation tables, fill tables, cooling tank, and wash sinks, may be constructed in accordance with specifications given for those items on pages 24 to 35 and in table 5. For information on the type of sealers to buy, see page 26.

The instructions, given in the preceding section of this publication, on operating the various items of equipment used in steam-operated plants apply also to the items of equipment used in small canning centers operated with gas burners, with the exception of retorts and pressure canners. Instructions for their operation follow the sections on their installation.

The blanch and scald tanks are constructed of 18-gage galvanized sheet metal made in a cylindrical shape. To strengthen these tanks the top has a rolled wire-band edge smoothly finished to prevent any injury from contact when they are in use. These tanks are supported on a separate base stand approximately 14 inches high so that the tank will be at a convenient working height. The base is made of angle-iron legs attached to a heavy-gage metal-band and seat arrangement. The tanks are removable from the base stand for cleaning. Cleaning and draining may be facilitated by fitting the tanks with adequate drain connections. The side skirt is made of light-gage metal extending down the angle-iron legs for a distance of 6 inches or more to bring it approximately 1 inch below the burner. The flue, also constructed of a light-gage metal, is insulated and extends vertically to a suitable outlet. The atmospheric wheel-type burner of approximately 107,000 B. t. u./hr. capacity with a Venturi mixing tube is recommended for heating these tanks. (See fig. 57.)

The medium tank used for heating water, brine, or sirup is placed on top of the fill table adjacent to the exhaust box at a height sufficient to clear the tallest can when filling the boiling liquid into the cans. The tank is constructed of heavy noncorrosive metal with a shallow funnel-type bottom to facilitate draining and cleaning. It is supported by a separate base constructed of three angle-iron legs attached to a heavy-gage metal band-and-seat arrangement. The supply pipe fits into a threaded flange at the center bottom of the tank and extends through the center of the burner with a T arrangement below the burner. The pipes extending from the T are fitted with faucets which permit the filling of the medium into the cans from both sides of the fill table. A light-gage metal skirt of sufficient depth to come at least 1 inch below the burner is provided at the base of the tank. The flue, also of a light-gage metal, is attached to the skirt and extends vertically to a suitable outlet. An atmospheric ring-type burner of approximately 40,000 B. t. u./hr. capacity with a Venturi mixing tube is recommended for heating the tank. (See fig. 58.)

The exhaust box constructed of 18-gage galvanized sheet metal should be insulated on the sides and bottom and should be fitted with a tight cover of proper design. Such insulation and cover will largely eliminate both radiation- and evaporation-heat losses and will protect the worker from possible burns. The box should be fitted with a false bottom of heavy wire

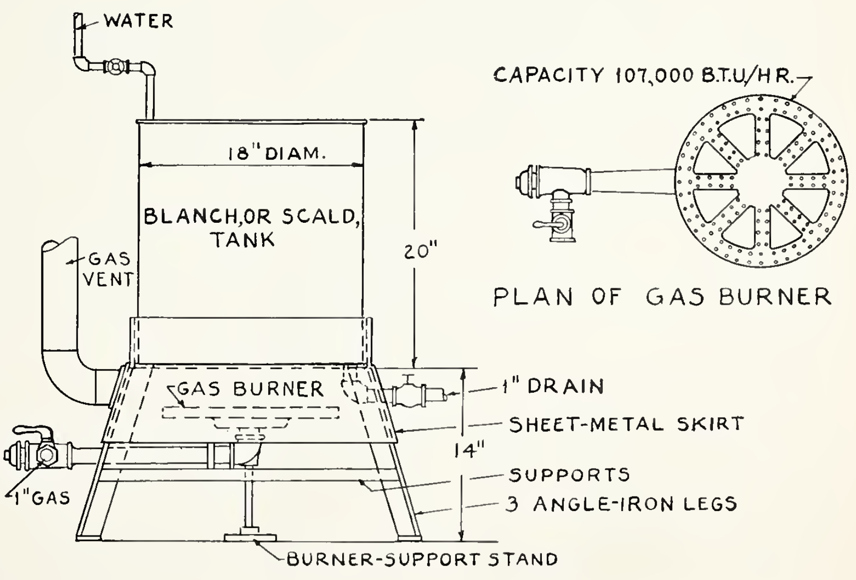

Figure 57.—Blanch, or scald, tank with wheel-type burner.

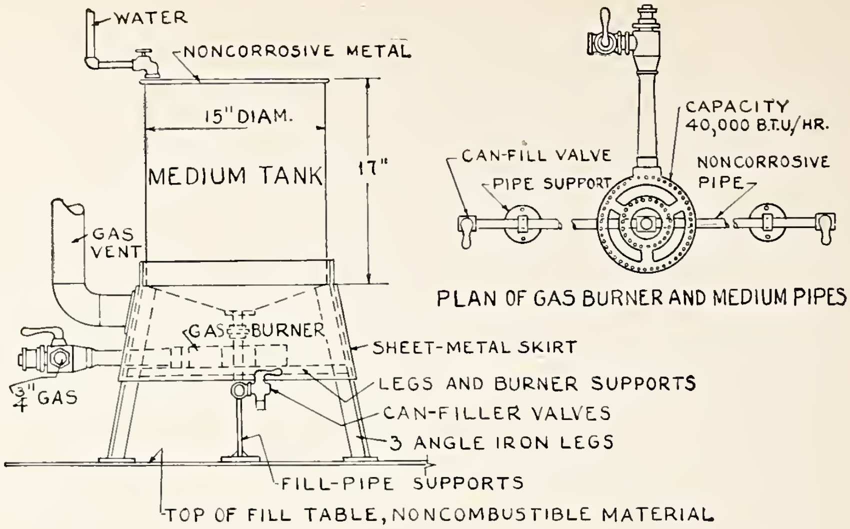

Figure 58.—Medium tank with ring-type burner.

mesh and an overflow drain of the proper height and size to prevent water from getting into the produce being exhausted. The immersion-type burner has been found to be quite satisfactory for heating the batch-type exhaust box. It should be fitted with a Venturi tube and have a capacity of approximately 125,000 B.t.u./hr. This type of burner is enclosed in such a manner that the flame does not come in contact with anything except the interior of the coil unit which is immersed below the water level in the box. The immersion coil which extends around the sides of the box is equipped with the proper-sized flue and draft hood which extends vertically to a suitable outlet. The draft hood fitted near the top of the draft flue prevents down drafts and flash backs in the operation of the immersion-type burner. (See fig. 59.)

Retorts of larger than 33 No. 3 can capacity should not be heated by gas burners. Specifications for retort equipment are given on page 13. A retort heated by a gas burner is supported on three heavy angle-iron legs at a height of approximately 14 inches from the floor. This places the retort at a convenient working height for loading and unloading by hand. The angle-iron legs which are set in a slightly slanting vertical position may be notched out at the top or angle-iron clips may be welded to the legs for the retort to rest on. Each leg is fitted with a ½-inch set screw to tighten against the retort body and hold it securely. Flat metal bars or round rods are welded to the legs below the burner in a triangular design to keep them in position. The skirt of light-gage metal fits around the base of the retort and extends down the legs to approximately 1 inch below the burner. It is fitted with a flue of the proper dimension which extends vertically to an adequate outlet. The burner, placed in central position under the retort, is supported by a pedestal which rests on the floor. An atmospheric wheel-type burner of approximately 85,000 B.t.u./hr. capacity is recommended for heating a 33 No. 3 can capacity retort. It should be fitted with a Venturi mixing tube. (See fig. 60.)

Operation of gas-heated retorts

Retorts heated with gas burners are operated in the same manner as those supplied with steam from a boiler, with the following exceptions:

1. Water provided in the retort is the source of steam. The water should be brought to the boiling point before the cans are placed in the retort. For a 33 No. 3 can capacity retort, 2½ gallons of water is used. This provides sufficient water to permit partial venting throughout a 30-minute processing period. If the processing period is longer, as in the case of meat, the amount of water should be increased. It is very important when operating retorts heated with a direct flame not to permit them to become dry.

2. A longer venting time is necessary in retorts which generate their own steam than in retorts connected to a pressure steam line. These self-heating retorts of 33 No. 3 can capacity should be vented for at least 25 minutes at 0 pound pressure (7).

The burner stand for a battery of pressure canners is made of heavy angle-iron and flat-metal rods of welded construction. It is recommended that the stand be made 18 inches high in order to facilitate the removal of the racks from the pressure canners with a minimum of effort. A ring-type burner of approximately 30,000 B. t. u./hr. capacity fitted with a Venturi mixing tube is adequate for heating a pressure canner of 14 to 18 No. 3 can capacity, the smallest sizes recommended for use in this type of plant. The burners are supported on metal rods at a sufficient distance from the pressure canners to assure proper combustion. A light-metal hood fitted with the proper-sized flue which extends vertically at the center back of the hood to an adequate outlet is provided along the back of the burner stand to carry off the products of combustion. (See fig. 61.)

Operation of pressure canners

Pressure canners used for the processing of nonacid foods in tin containers are operated in the same manner as retorts heated with gas burners except that the pet-cock or vent valve is usually closed at the end of the venting period. This is done to conserve the water needed to generate steam in the canner. Approximately

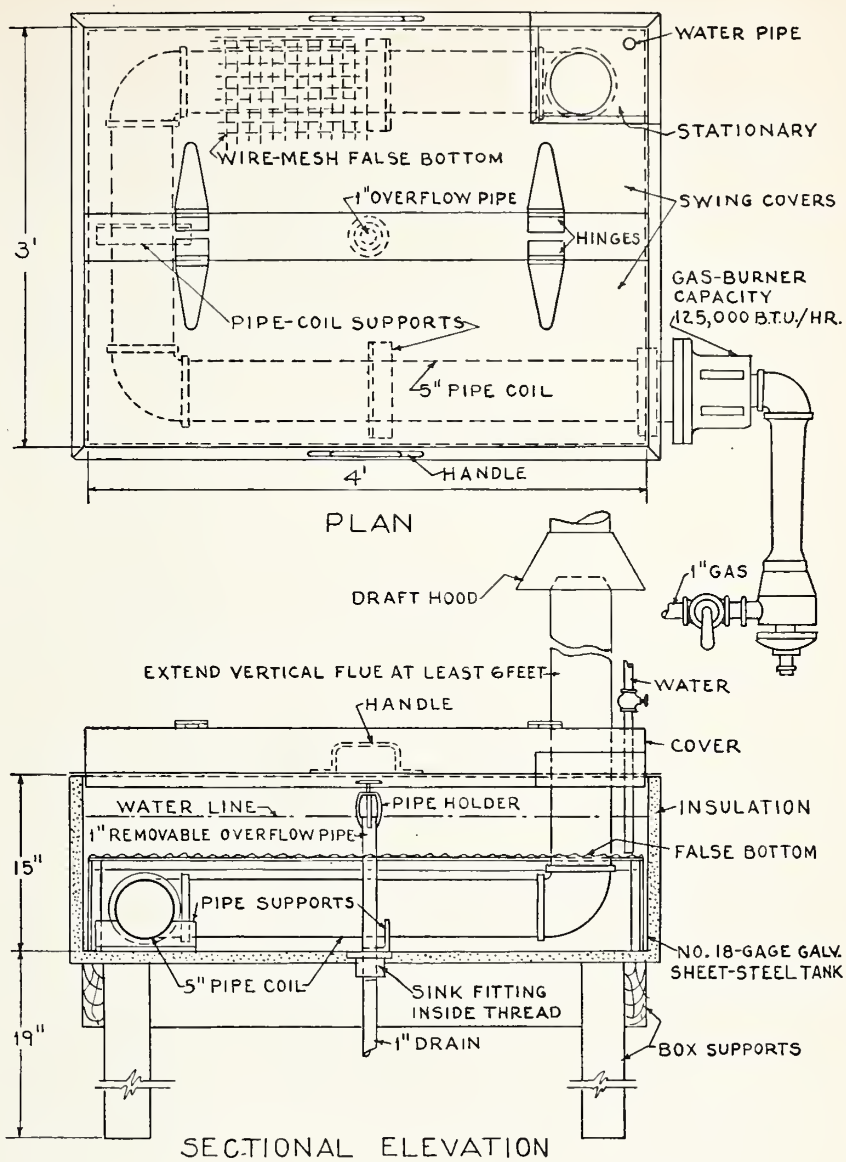

Figure 59.—Exhaust box with immersion-type burner.

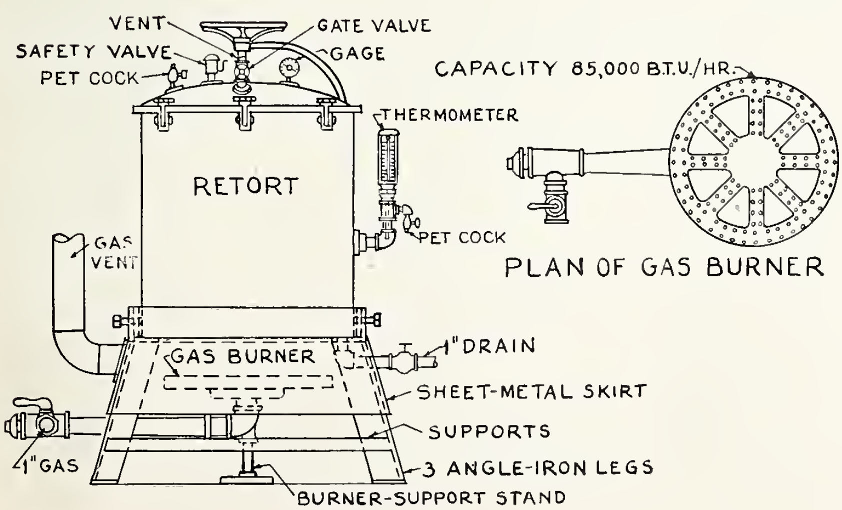

Figure 60.—Retort with wheel-type burner and stand.

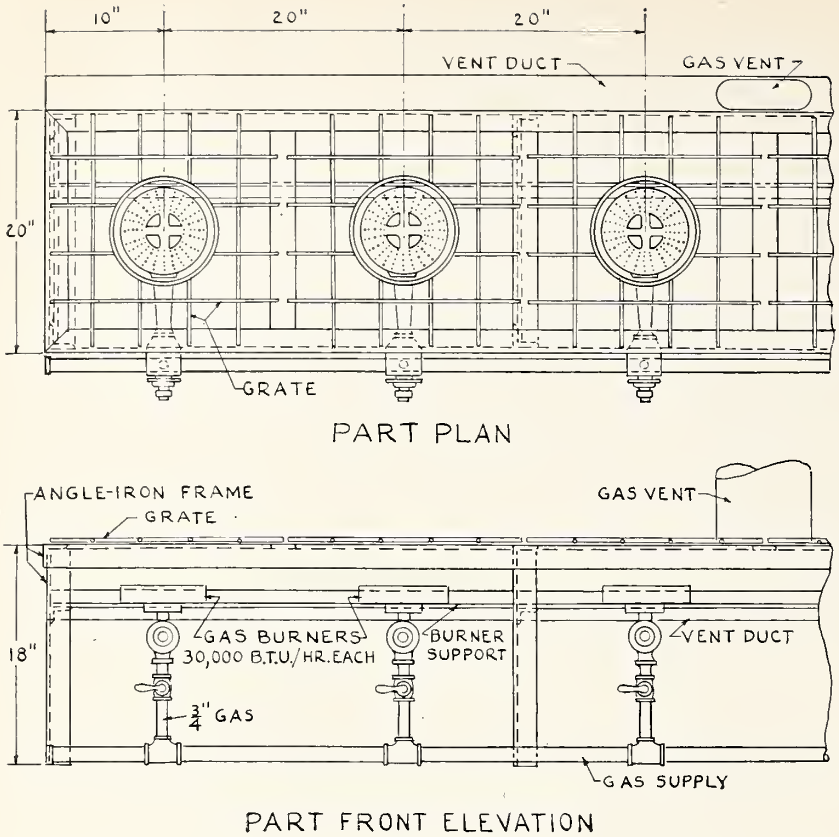

Figure 61.—Burner stand for battery of pressure canners.

4 inches of water should be put in the canner and brought to a boil before the cans are placed in the canner. To permit the full circulation of steam throughout the canner, cans should be stacked in the canner rack in the manner recommended for stacking cans in retort baskets. To remove all air from the canner it must be vented for at least 10 minutes (*6*), counting the venting time when steam escapes freely from the open vent or pet cock with an audible sound. This venting time applies to canners of the size recommended in this publication for use in community canneries.

To vent the pressure canner, open wide the pet-cock bleeder. At the end of the venting period close the pet-cock bleeder or vent and allow the pressure to come up as quickly as possible to the pressure desired for processing. As soon as this pressure has been reached, record the time and adjust the flame so that the pressure will be maintained at the point desired as uniformly as possible. It is well to have the patron whose food is being processed watch the pressure canner to avoid fluctuations in pressure. At the end of the processing period turn off the flame and open the pet cock gradually to release the pressure. When the pressure has returned to 0 open the canner promptly. Tilt the lid so that the steam emerges away from the operator. Remove the cans for cooling.

Care of pressure canners

Wash the pressure canners every day and more often if needed. Keep the surfaces that form the closure between the pot and the cover clean. This will reduce the tendency of the cover to stick. Take care not to dent or roughen these surfaces. Do not use an abrasive on them. New pressure canners sometimes leak steam slightly at this juncture but after being heated several times, the surfaces should adjust to each other to make the closure tight.

As pressure gages are usually the only instrument provided on pressure canners for determining the temperature inside the canner it is particularly important that the gages be accurate. (See p. 20, Testing Pressure Gages.) It is also important that the safety valve be dismantled and cleaned periodically as gumlike substances sometimes form in the valve and interfere with its normal operation. When a pressure canner is not in use for any period of time the mechanism inside the safety valve should be cleaned and then oiled lightly with a light tasteless mineral oil. Do not submerge pressure-canner covers in water when cleaning them. If that is done, the water may enter the pressure gage and corrode and finally destroy the gage mechanism. Keep the canner lid upright and in position on the canner when not in use.

Care of idle equipment

During the periods equipment is not in use it should be given special care to prevent rusting and corroding. The boiler should be thoroughly flushed out and refilled and ½ gallon of lubricating oil added to the top of the water. When the boiler is then drained the oil will coat the inside surfaces and keep them from rusting.

Remove gages, pet cocks, and thermometers from retorts and steam pipes, wrap them in heavy paper, and label them carefully to indicate the part and location. Clean thoroughly such equipment as retorts, exhaust boxes, pressure canners, and mechanical equipment; dry and treat all surfaces that are likely to rust with a heavy grease such as that used on an automobile chassis. Parts of equipment that need to be removed should be wrapped and placed with the equipment. Carefully inspect equipment for wear and make note of needed repairs. Steam-jacketed kettles and blanching baskets made of noncorrosive material may be covered with heavy paper for protection from dust when they have been thoroughly cleaned. Check sealers for repair and replacement, oil where needed, and grease the external parts to prevent rusting. It is well to store sealers in their original shipping boxes, keeping all attachments together in a small sack, labeled, and stored in the box with the sealer. Small equipment, such as peeling knives and sharpening tools, also need to be thoroughly cleaned, wrapped in paper, and labeled before storing. Check belting and hose for wear and replacement and store in a cool dry place. Make an inventory of all equipment at the close of the season as well as at stated intervals during the operation period.

Sanitation

In those States that have regulations governing food-processing plants such regulations should be obtained and posted at the canning center. A high degree of sanitation is necessary if good results in canning are to be realized. Items of equipment, such as scald and blanch tanks, medium tanks, exhaust boxes, and sealers, will need to be thoroughly cleaned at the end of the working day. All equipment and utensils which come in contact with food should be treated with a germicidal compound after each day's use. Cutting boards and table tops need special treatment to keep bacteria under control. Scrape them, scrub with hot, soapy water, and rinse with boiling water or apply steam. Then disinfect them, using a hypochlorite solution or a chloride of lime bleaching fluid diluted according to directions on the can. Let the solution stay on for about half an hour, then wash off with scalding water and treat with steam. Linoleum-surfaced table tops are not satisfactory for preparing meat as they cannot be scalded or disinfected without injury to the surface. Such items as peelers, pulpers, grinders, and the exhaust box are left dismantled for airing and thorough cooling and should be flushed with cold water before they are used again. Other important points in maintaining plant sanitation are as follows:

1. Make provisions for the regular disposal of garbage. Wash and, if possible, steam all garbage cans every day. Leave them open until time for use again.
2. Scrub and dry floors at least once a day. Flushing floors during shut-down periods or at meal time is frequently necessary. A squeegee or broom is used for removing excess water from the floor.
3. Keep walls, woodwork, and windows clean. Keep screens free from dust. Do not use window curtains as they catch and scatter dust in the cannery.
4. Clean toilets and lavatories and treat daily with a disinfecting solution.
5. Provide sanitary drinking fountains or individual paper cups for employees and patrons.
6. Sprinkle the area around the cannery with oil or cover with calcium chloride to keep dust down.
7. It is desirable that employees wear clean uniforms each day. Uniforms or towels should not be laundered in the cannery.

Safety

The importance of making the community cannery a safe place to work cannot be overemphasized. The supervisor should inform herself of all safety regulations applicable in the area in which the cannery is located. In addition to the safety precautions mentioned in connection with the installation and operation of equipment the following are also important:

1. See that stairways and entries are well lighted.
2. Equip platforms and stairs on which patrons walk or work with handrails that are securely fastened at a height for convenient use.
3. Provide the ladders used in the plant with pads or points to prevent their slipping.
4. Keep floors clean and free of excess water and accumulated refuse.
5. See that stools, tables, and other wooden equipment are of solid construction and free from rough edges or splinters.
6. Do not repair machinery while it is in operation.
7. Protect exposed gears, belts, sprockets, chains, and shaftings, with secure guards to avoid the entangling of any clothing or object.
8. Protect and ground electrical equipment in accordance with existing codes. When pull-chain sockets are used they should be insulated.
9. Do not attempt to repair boiler lines or steam fittings while the steam system is under pressure, as this may result in serious injury to persons or cause property damage.
10. Place fire extinguishers at convenient locations in the plant and check them regularly to see that they are properly charged.
11. Where gasoline stoves are used, place them in large, shallow boxes of sand. Keep additional sand in buckets or provide a foam-type extinguisher to be used if fire should result from use of such stoves. Make no attempt to fill gasoline stoves while there are other stoves in operation or flames burning nearby. Such stoves should not be refueled inside the building.
12. Check retort crates, bails, and hoisting equipment at frequent intervals for defects.
13. Teach patrons the proper method of handling tools.
14. Advise patrons and employees to wear low-heeled, comfortable shoes to avoid slipping on floors.
15. Keep first-aid cabinets well stocked at all times. Give training in first aid to employees.
16. Provide salt tablets during hot weather to prevent heat exhaustion.
17. Provide aprons, boots, and gloves of rubber or acid-resistant material to protect the worker where caustic alkali is used.

Management

Personnel—employed and volunteer

In getting ready for plant operation the supervisor and cannery committee must decide on the number of employees needed to operate the plant and how they will be selected. In a community cannery, patrons usually prepare their own produce, fill it into the cans, and mark the cans. Patrons also assume responsibility for cleaning the equipment and the space they have used in preparing their products, and for disposing of any refuse from their products. In small canneries it may be necessary for patrons to assume other jobs, but in most instances it is best to employ regular personnel for such jobs as operating the retorts and sealer. In all instances an experienced boiler operator should be employed. In some States boiler operators must be licensed. The boiler operator should give full attention to boiler operation and the maintenance of the steam lines in a plant. He should not be required to do other tasks that will take him away from the boiler for any length of time.

During processing periods, if a person is not hired to spend full time with the retorts, a responsible patron should be assigned to this job. Other jobs that may be performed near the retorts include loading of filled cans into the retort crates, and cooling and unloading of the processed cans. In units where pressure canners are used each patron should be made responsible for his own canner. Gages should have faces sufficiently large so that the floor supervisor can note at a glance the pressure indicated and, if the pressure is not correct, call the fact to the attention of the patron responsible.

The sealer operator, if one is employed, and the supervisor should be trained to test can seams and to make the necessary sealer adjustments. They, as well as all other employees, should be responsible for the daily upkeep and care of the equipment which they operate.

In large plants it is usually advisable to employ an assistant to the supervisor to help in receiving produce, training patrons, and general supervision of the work of the plant. Such a person will need to be as capable and as well trained as the supervisor in operating the cannery and in teaching or directing others.

Other employees might include: *A clerk*, to be responsible for making appointments, maintaining records, receiving money from patrons, and releasing canned goods; a *janitor* for general cleaning and refuse removal; *an additional key employee* who can be trained to replace anyone in the plant. Such an employee could relieve the retort operator and sealer operator during rest and lunch periods, or replace either one in an emergency, so that plant operations will not need to be curtailed in their absence. Other jobs that might be assumed by this person would include brine and sirup making and the issuing of cans to patrons.

Some communities have found it advantageous to use volunteer workers in their canning centers. Such workers usually assume the responsibility of instructing patrons in the preparation of their produce. *Volunteer workers should not operate boilers, sealers, retorts, or other pressure equipment unless they are fully qualified to do so.* When such workers are so used it is important to select those who can be depended on for a definite period of time.

Protection for employees and patrons

It is always wise in a community venture, such as a canning center, to insure employees and patrons against accidents that may occur.

Many canneries carry Workmen's Compensation Insurance which pays wages to employees in case of disability. Some canneries also carry a public liability policy and a boiler insurance policy for protection of patrons as well as employees in case of personal injury due to an accident at the cannery. The latter policy usually covers damage to property as well as personal injury.

If a cannery is operated under the supervision of a school which carries a public liability policy, the cannery usually can be included in this policy at a lower premium rate than would be charged for an independent policy.

Getting information to the public

Newspapers, local merchants, women's clubs, garden clubs, schools and radio stations can give valuable help in publicizing the community cannery and its program if the information is made available to them by the cannery committee and the supervisor. To be effective, this information should follow a general pattern commencing with the organization of the cannery. Throughout the canning season some member of the committee should be responsible for compiling and releasing pertinent information at stated intervals.

Newspapers and radio stations especially should be furnished with: Copies of agreements between the cannery and patrons; advance information on when the cannery will open; when and where people may make appointments for using the cannery's facilities; and what produce may be canned. They also should be given the names of the cannery committee members and their work.

Gas and electric-light companies may be willing to cooperate with the program to the extent of mailing informational circulars with their monthly bills.

If certain days are to be set aside for canning a particular product the notice should appear in the newspapers in advance. This allows patrons time to make their appointments with the cannery. Local stores that carry produce for canning may want to include notices of canning dates in their regular advertisements.

Items of public interest, such as outstanding accomplishments of the cannery, should be reported both to radio stations and to newspapers as they occur. Newspapers may also be interested in well-illustrated articles on the cannery program for use in their Sunday issues.

Education and training for patrons

If the community cannery is to operate successfully and become a permanent facility in the community, all groups of people using the cannery must become increasingly skilled in its use and operation and be willing to support it.

In order that the cannery may operate effectively, an educational program should be conducted on: (1) Planning, (2) producing, and (3) conserving the family food supply. The program should begin before the planting season of the products which are to be conserved.

Individuals enrolled in any part of this educational program should be organized into groups of teachable size, based on: (1) Size of the cannery, (2) equipment available, (3) products to be processed, (4) previous experience in using canning equipment, (5) area from which patrons come, (6) time best suited to them, and (7) number to be trained. A seasonal sequence of instruction should be followed in all phases of this training. The training program will be most effective when taught just prior to or in connection with activities carried on by the groups or individuals in processing their own products.

In order to carry out this educational program, it will be necessary to use the existing educational agencies or other services available in the community. One of the responsibilities of the local advisory committee will be to designate qualified persons to serve as instructors for the training program, especially as it pertains to planning, producing, and conserving food. An educational program of this kind has been handled successfully in local communities by teachers of vocational agriculture and home economics, county Extension Service agents, county Farm Security Administration supervisors, garden-club leaders, and other trained or qualified individuals and groups. Experience has shown that greater quantities of more desirable food will be conserved by each family if the homemaker is given systematic instruction and training on planning the food needs, food production, and food-processing practices. The educational program will provide the supervisor with definite information regarding the number of patrons planning to use the cannery and the amount of produce that will be processed in the cannery during the season.

Planning food for the family

To get the greatest benefit from the community cannery, a family should be given training in developing a food budget. This is done by listing the kinds and quantities of food that will be needed by the family during the year. The food budget includes all foods that are produced in family gardens as well as those purchased from local markets or producers. The quantities of fruits and vegetables in the food budget should include those to be eaten fresh as well as those to be conserved for later use, by storing fresh or by canning, freezing, brining, and dehydrating.

TABLE 6.—*Family food plan at moderate cost*

Family members	Kinds and quantities of food for a week										
	Milk [1]	Potatoes, sweetpotatoes	Dry beans and peas, nuts	Citrus fruit, tomatoes	Green, yellow vegetables	Other vegetables and fruit	Eggs	Meat, poultry, fish	Flour,[2] cereals	Fats and oils	Sugar, sirups, preserves
Children under 12 years:	*Qt.*	*Lb. Oz.*	*Lb. Oz.*	*Lb. Oz.*	*Lb. Oz.*	*Lb. Oz.*	*No.*	*Lb. Oz.*	*Lb Oz*	*Lb. Oz.*	*Lb. Oz.*
9–12 months	7	0 8	-------	2 0	1 8	0 8	5	0 2	0 8	0 1	0 1
1–3 years	5	1 0	-------	1 12	1 8	1 0	5	0 8	1 8	0 4	0 2
4–6 years	5	1 8	0 2	1 8	1 8	1 8	5	1 0	2 0	0 6	0 8
7–9 years	5	2 8	0 2	1 8	1 8	2 8	5	1 8	2 8	0 10	0 8
10–12 years	6	3 0	0 2	1 8	1 8	2 8	5	2 0	3 4	0 12	0 10
Girls:											
13–15 years	6	3 8	0 4	1 12	1 8	2 8	5	2 0	4 0	0 14	0 10
16–20 years	5	3 0	0 4	1 12	1 8	2 8	5	2 0	3 8	0 12	0 10
Women:											
Moderately active	4½	3 0	0 6	1 8	1 8	2 8	4	2 0	3 8	0 12	0 12
Very active	5½	4 0	0 12	1 8	1 8	2 8	4	2 0	4 12	1 0	0 12
Sedentary	4½	2 0	0 4	1 8	1 8	2 8	4	2 0	2 8	0 12	0 12
Pregnant	7	2 0	0 6	2 0	2 0	2 8	6	2 5	3 0	0 12	0 10
Nursing	10½	4 0	0 6	3 0	3 0	3 8	6	2 5	3 0	0 12	0 10
Boys:											
13–15 years	6	4 0	0 8	1 12	2 0	3 0	5	2 0	5 0	1 2	0 12
16–20 years	6	5 0	0 12	1 12	2 0	3 0	5	2 0	7 0	1 6	0 12
Men:											
Moderately active	5	4 0	0 12	1 8	1 8	2 8	4	2 0	4 12	1 0	0 12
Very active	6	7 0	1 0	1 8	1 8	2 8	4	2 0	9 0	1 10	0 12
Sedentary	5	3 0	0 6	1 8	1 8	2 8	4	2 0	3 8	0 12	0 12

[1] Or its equivalent in cheese, evaporated milk, or dry milk.
[2] Count 1½ pounds of bread as 1 pound of flour.

Bureau of Human Nutrition and Home Economics, U. S. Department of Agriculture (*10*).

Nutritional requirements of the family

To meet the nutritional requirements of the family, the food budget should be based on the Basic 7 food groups as outlined by the Bureau of Human Nutrition and Home Economics (*10*). The family food plan at moderate cost shown in that publication and reproduced herein as table 6, can serve as a basis for determining the quantities of food needed to meet the nutritional requirements of the average family on a weekly, monthly, and yearly basis.

Quantity of each food to be canned

The quantity of food to be preserved by canning would depend on other methods of preservation available and on the length of the season when canned foods, rather than fresh products, are to be used. Food-preservation budgets, such as the one shown in table 7, are available in most States and may be used as a pattern in determining the amounts and varieties of food to be preserved by any one family. Although this budget was set up for rural families it may be adapted to the use of urban families. When setting up an individual family budget it is important to keep in mind the variation of produce even within a State and to have the budget include foods that are available on the local markets as well as those that are home-produced. Families should be taught how to plan individual food budgets that are adapted to their own needs.

TABLE 7.—*Family food-preservation budget*

Product	Amount to can [1]	
	For 1 person	For my family
Tomatoes and tomato juice	30 qt	
Green and yellow vegetables	20 qt	
5–7 qt. greens:		
Wild greens		
Spinach		
Mustard		
Chard		
Turnip greens, etc		
10–15 qt. other green vegetables:		
Young green beans		
Peas		
Asparagus, green		
1–2 qt. yellow vegetables:		
Carrots		
Sweetpotatoes		
Other vegetables and fruit	50 qt	
10–20 qt. of vegetables:		
Vegetable soup mixture		
Mature green beans		
Baby beets		
Corn		
Sauerkraut		
30–40 qt. fruits:		
Apples		
Peaches		
Pears		
Rhubarb		
Plums		
Grapes		
Cherries		
Berries		
Apricots		
Apple, peach, pear, rhubarb, plum, grape, cherry, and berry juices		
8–12 pts. pickles, relishes, catsup, etc	5 qt	
8–12 pt. jams, jellies, preserves, etc	5 qt	
Meat	20 qt	
8–12 pt. pork		
8–22 pt. beef		
8–12 pt. chicken and other meats		

Product	Amount to store, dry, brine, and cure	
	For 1 person	For my family
Potatoes	3 bu	
2–3 bu. (Irish)		
1 bu. sweetpotatoes		
Cabbage and Chinese cabbage (about 10 heads).	1 bu	
Yellow vegetables	1 bu	
½ bu. carrots		
½ bu. Hubbard squash		
Sweetpotatoes (as above)		
Other vegetables and fruit	4 bu	
1–3 bu. vegetables:		
Turnips		
Beets		
Onions		
Parsnips		
Salsify		
Rutabagas		
Squash and pumpkin		
1–3 bu. fruits:		
Apples		
Pears		
Dried vegetables and fruits	4 gal	
2–3 gal. vegetables:		
Corn, beans, peas, soybeans		
1–2 gal. fruits:		
Apples, peaches, pears		
Meat:		
Cured pork	20 lb	
Cured bacon	10 lb	
Lard	1 gal	
Sorghum and honey	2 gal	
Sauerkraut (cabbage and turnip)	1 gal	
Nuts (in shell): Peanuts, hickory, walnuts, hazel, pecans	1 bu	
Whole wheat for cereal and other dishes	1 gal	
Popcorn, on cob	2 gal	

[1] If a freezer locker is used, reduce the number of quarts canned according to the amount placed in the locker.

From Missouri Agricultural Extension Service (*5, p. 8*).

Food-production possibilities

In making out the family food budget the foods that can be produced at home will need to be considered. One large planting for canning will save time and transportation for patrons. Plantings for canning purposes should be made at the season most favorable for producing those fruits and vegetables adapted to any given area. This will not be as difficult for those people living on farms as for the urban dweller who will have to decide which products to plant in order to get the most value from the available garden space.

After the food budget for the family has been decided on, systematic instruction and study should be undertaken with respect to: (1) Determining size of garden; (2) selecting site for garden; (3) determining amount of seed needed; (4) selecting and obtaining kinds and amounts of fertilizers; and (5) other activities which are needed in connection with planning for the family food supply.

Producing food for family use

Where families have their own gardens several group meetings should be held just before and during the growing season to study the methods used by successful growers in the community and the recommendations of State experiment stations. These studies include: (1) Preparing the seedbed; (2) selecting varieties best adapted to the local area and for canning; (3) succession planting of crops to avoid overcrowding of the cannery; (4) starting plants in hotbeds or cold frames; (5) pruning; (6) spraying; (7) cultivating; and (8) harvesting.

Prior to the time when the fruits or vegetables are ready to be harvested or purchased for canning, a few group meetings should be held to discuss such problems as: (1) The stage of maturity of the produce that will insure a high-quality finished product; (2) the proper type of containers for harvesting and transporting produce to the cannery; (3) the quantity of produce to be harvested for processing during any one day; (4) time of day best suited for harvesting; (5) holding certain produce for processing by using temporary storage; and (6) preparatory steps to be taken before the produce is brought to the cannery.

This systematic instruction on providing the family food should be supplemented by posters, postal-card folders, news articles, circular letters, or other devices that will inform the patrons of planning, producing, and processing activities.

Instructing families in canning practices

Specific instructions should be given the patrons on preparation practices and canning techniques to be followed in the various steps of the canning operation. The individuals responsible for the training program may be able to obtain the services of experienced patrons or volunteer workers to assist in the training of inexperienced patrons in the preparation of produce and the techniques of canning food. Instruction also must be given on the operation and use of equipment.

The use of trained employees to operate, maintain, and adjust the intricate pieces of canning equipment, such as boilers and retorts, will: (1) Increase the amount of food processed; (2) aid in more efficient operation of the plant; and (3) insure a high-quality canned product. The supervisor of the community canning plant will need to train employees or other persons to operate the equipment.

If the person responsible for the training program has had teaching experience that includes job analysis, little difficulty should be experienced in training the employees and patrons in canning procedures and operations.

In order that the instructor may make a job analysis it will be necessary to decide first, what specific job is to be taught. No attempt should be made to teach all the activities that take place in the operation of a cannery at one time. Instead, it is considered desirable to teach a person only one operation at a time.

The instructor should list all the important steps in the order in which they must be done. Each step listed should be accurate, brief, and clear. This is important because, quite often, the instructor may know how to do the job so well that he does some step automatically and may not teach that step to the learner.

The instructor should list the key points in each step. A key point is anything in a step that might make or ruin the job, injure the worker, or make the work easier to do. The key points to be listed are the techniques which are to be emphasized at each step of the operation if a thorough job of instruction is to be accomplished.

Before using the teaching plan with individuals or groups, the instructor should do the job according to the plan developed and check to see that all steps and key points have been included.

A break-down of all jobs connected with the preparation and processing of the produce and the operation of each piece of equipment should be outlined and training given the individuals who are to do these jobs.

The direct or lecture method of teaching gives individuals information about a canning technique but does not train the individual to acquire skill in performing the task. Similarly, a demonstration without explanation will show the individual how to perform a task but does not give information about the job or practical experience in performing it skillfully. The teacher who uses a combination of both methods of instruction plus the technique of having the patron "learn through doing" will carry on the most effective training program. In using this procedure the instructor should outline the important steps in doing each job and the essential points to observe in performing each step. The correct equipment and all necessary materials and supplies should be available and correctly arranged for doing the particular job to be taught. The following procedure has been found effective in training inexperienced persons to do canning:

Step 1.—The instructor should state clearly the specific job to be done and stress the importance of

performing each operation correctly. Persons having previous canning experience may demonstrate their skill and if proficient, proceed with the work.

Step 2.—The instructor should explain and demonstrate the job in clearly defined steps, stressing the points which will result in success or failure. Charts, pictures, films, and other illustrations may be used to emphasize these points. It may be necessary to explain and demonstrate some steps several times in order to teach clearly the skills to individuals.

Step 3.—Each trainee should do the job under close supervision, the instructor attempting to prevent errors. It is a good practice to have the trainee point out the essential steps he has performed in doing the job. Questions may be raised as to what, how, and why he has carried out each operation. Have each trainee repeat the job under supervision until he understands and can perform each operation.

Step 4.—The training will be more effective if the person does the job immediately in connection with processing his own produce or operating the piece of equipment to which he has been assigned. If certain points are not clear, questions should be encouraged to clear up these points. At first the instructor should check frequently the work being done. Less supervision will be required as the person acquires skill. The instructor should designate some person to assist in giving information to patrons on canning operations or in operating canning equipment.

The use of wall charts (fig. 62), approximately 3 by 4 feet in size, on which are listed the several steps that need to be followed in processing each of the more common commodities is a good teaching device and will aid the patron to follow the recommended processing practices of the instructor.

CANNING TOMATOES

1. Sorting:
   - For size.
   - Ripeness.
   - Soundness.
2. Washing.
3. Scalding.
4. Cold dipping.
5. Peeling.
6. Washing cans.
7. Seasoning:
   - No. 3 cans, 1 teaspoon salt.
   - No. 2 cans, ½ teaspoon salt.
8. Pack tomatoes to ¼ inch of the top of can.
9. Exhausting to 140° F., center can temperature.
10. Sealing cans.
11. Marking cans.
12. Processing:
    - No. 2 cans, 45 minutes.
    - No. 3 cans, 55 minutes.
13. Cooling to 100° F.
14. Cleaning utensils.
15. Checking out.

Figure 62.—A sample chart on canning tomatoes. Similar wall charts will aid in teaching the following: Processing times and temperatures; number of cans required for measured quantities of produce; recommended type of container for each product; instructions for making sirup and brine; and the use of salt tablets.

Patron's agreement

An agreement outlining policies and regulations that have been adopted by the cannery committee is usually presented to patrons the first time they come to the cannery. Before operations begin, patrons are required to sign this agreement indicating that they fully understand its terms and are willing to comply.

Such an agreement might include the following:

1. The standards of operation and techniques of canning adopted by the canning center.
2. Divisions of labor; namely, the work the patron will do at the cannery and what services the cannery will supply.
3. Cost per can the patron will be expected to pay.
4. A list of materials and supplies to be furnished by the cannery and those the patron must furnish.
5. A statement of plant policy on spoilage of products.
6. Regulations on registration and scheduling.
7. Rules on cancellation of appointments, either by patron or by cannery supervisor.
8. The types of produce that may be canned.

Appointments and scheduling

If the cannery is to operate with any degree of success, patrons must make appointments with the supervisor for the use of it. Such appointments should be made several days in advance of the day the canning is to be done so that a plan of work may be set up and operating needs determined. Produce of like types should be grouped in the quantities and sequence necessary to insure a smooth flow of work and the maximum use of the equipment.

During the peak production season it would be well to have special days for canning produce in abundance, such as peach day or corn day. Where it is necessary to can several kinds of produce in one day the number should be kept to a minimum. Care should be taken not to schedule produce that will compete for the same equipment. Tomatoes, which are processed in the water bath, can be scheduled for canning at the same time as vegetables processed under pressure, such as snap beans or peas. When the quantity of produce of any one kind is not sufficient to fill the retort or open-process tanks, those products requiring the same processing time and temperature should be scheduled together, if possible. In that way the full capacity of each processing vessel can be utilized and the maximum production for each day assured. Table 4, on page 39, which gives the approximate number of cans required for measured quantities of produce, will be helpful in figuring the number of cans to be processed.

When scheduling vegetables and fruits, preference should be given to the more perishable ones. The harvest of root crops may easily be delayed if necessary, so that perishable items, such as corn or peas at the right stage of maturity for canning, can be cared for promptly. Small fruits and berries need immediate care if waste from spoilage is to be avoided.

A standard form, such as the one shown in figure 63, will serve as an appointment schedule, production record, and receipt for the amount paid by the patron. It should be made out in duplicate so that both the plant and the patron will have the same record.

Name_______________	Date_______________
Address_______________	Time a. m._______ p. m._______
	Patron's No_______________
	Telephone_______________

Produce	Amount to be canned	Size of can	Number of cans	Cost per can	Total cost	Remarks

Total number of cans_______________

Amount paid_______________

____
Supervisor

Figure 63.—Patron's appointment record and receipt.

At the time the appointment is made the patrons should be advised of the hour and day on which they are to report to the cannery and how many helpers to bring to assist with the job. This will vary with the produce to be canned and the experience of the worker. Where patrons are required to bring supplies, such as sugar, they should be advised of the amount needed. This will vary with the produce and the way in which it is to be canned.

The supervisor should have a daily operating schedule, using a form such as the one shown in figure 64.

____
Month Day Year

Time	Patron's name	Patron's number	Produce	Amount	Size of cans

Figure 64.—Daily operating schedule.

If such a schedule is made up as appointments are made, the supervisor can more effectively regulate the amount and kind of produce to be canned as well as the number of patrons who will use the cannery on any one day. To get the maximum use of equipment it is well to schedule the largest group of patrons for early in the day. If the cannery is to close at the end of a normal working day, patrons should not be scheduled for appointments later than 3 p. m. This will allow the time necessary to complete canning operations and the cleaning of the plant by closing time. During peak periods of production it may be necessary to schedule appointments over a longer operating day.

A review of the schedule in advance of the day of operation makes it possible to adjust appointments if changes need to be made. This advance check will also allow time for making a plan of work so that employees and volunteer workers can be informed of their responsibilities and given necessary training.

The number, size, and type of containers and corresponding lids needed should be ascertained and checked to see that they are on hand. Other supplies that may be needed should also be determined and made available. All facilities should be checked and equipment should be adjusted for operation. Such fore-

thought will net improved efficiency in the day's operation.

Staggered lunch periods for regular employees should be planned to insure continuous operation of the plant throughout the day. Schedule one person to relieve, as necessary, those in key positions. Each employee should report to work as the day's schedule requires his services. The boiler operator, for example, should come early enough to have steam up when operations begin. The sealer and retort operator need not report until later. Others are scheduled according to their respective duties. Rest periods for each employee should be allowed both during the morning and afternoon.

Canning procedure

Receiving produce

As patrons arrive with their produce it is checked in and recorded on the individual patron's appointment record and receipt card. (See fig. 63.) The patron is issued a number, which is also recorded on the card. Canneries vary their methods of assigning numbers. Some assign new numbers each day, some each week, whereas others have their patrons use the the same number for the entire canning season. Where new numbers are assigned each day, or each week, it is necessary to stamp the date on each can in order to avoid confusion in identification of patrons' produce. The condition of the produce at the time of delivery to the cannery should be noted and reported on the card under "Remarks" as this information may be of value if spoilage occurs.

Unripe fruit or tomatoes, wilted vegetables, or produce that has matured beyond the stage for successful canning should be rejected. Produce showing marked signs of spoilage should also be rejected. If a patron insists upon canning such produce he should be required to sign an agreement to the effect that the cannery will not be held responsible for spoilage or for the quality of the finished product. If patrons bring more produce than can be handled promptly it should be stored in a cool, well-ventilated place. Such produce should be tagged with the patron's number.

Preparation of produce

Preparation of the produce is usually assumed by the patron and includes all the steps necessary for getting the produce ready and placed into cans. Each patron is given space at the preparation table and instructions for preparing the particular product to be canned. The supervisor should explain the steps in preparation according to the sequence of operations and explain the necessity of cleanliness and prompt handling. Mistakes can be avoided if the sequence of operations in the preparation of produce is printed on charts and posted on the wall near the preparation table. (See fig. 62.)

Grading

Grading for quality as practiced by commercial canners is not necessary in a community cannery. However, where produce is to be steamed for peeling, it should be graded for size in order to get uniform results. It is also desirable to grade for uniformity of size where heat penetration in processing is a factor. For instance, large beets and carrots must be cut in wedges or cubes to insure proper heat penetration, while the small ones may be canned whole.

Sorting

Sort and inspect produce for defects, throughout the preparation period, to insure a product of the best quality. As the produce is being removed from the hamper discard all bruised, shriveled, discolored, or soured portions. If produce has been held overnight, it should be checked carefully for signs of sweating or sliminess caused by overheating. In sorting, remove immature and overripe produce. Insofar as is practicable, sand or dirt and foreign material should be removed at this time, in order to expedite the washing process. Sorting is continued through all steps of preparation and questionable portions should be discarded rather than risk spoilage of the finished product.

Soaking

Soaking may be necessary before washing root crops or other produce on which dirt has dried. However, soak produce only when necessary for this step slows up preparation.

Washing

Washing is not always the first step in the preparation of fruits and vegetables, but it is one of the most important steps of the canning process. Its purpose is to remove dirt and foreign material and to reduce the number of spoilage organisms present on the raw food. It also removes any spray residue that may have been left on the produce. To obtain these results a clean, safe, water supply is necessary. Water must be changed often enough to assure a thorough cleansing of the produce and to keep the number of bacteria down to a minimum. Enough water must be used to allow for moving and turning of the produce freely in washing. When washing greens, small quantities of them should be placed in the washing tank at one time to avoid matting and to permit thorough cleansing. Root crops will need to be scrubbed with vegetable brushes. When washing small fruits use a large strainer or wire basket that has a small mesh to avoid crushing the fruit through unnecessary handling. The fruit is placed in a shallow layer in a container and is cleaned by dipping the basket up and down in the water until the dirt and sand are removed.

Cutting, breaking, peeling

Cutting, breaking, peeling, or removing stems, husks, or cores should be accompanied by close inspection of the produce and removal of all undesirable

portions. Heat penetrates faster in processing when the produce is cut or broken in uniform sizes. Rapid work will lessen discoloration from oxidation and help to assure a finished product of high quality.

Discoloration

Discoloration in peaches, pears, and apples may be avoided by rapid preparation. When delay cannot be avoided after fruit is peeled and cut, the pieces of fruit may be placed in a wire basket and dipped into a solution of 2-percent acid brine.

Some products also are discolored through the use of knives that have iron blades or when the cut pieces are placed in a copper, iron, or galvanized iron container. It is, therefore, best to use containers of aluminum, tin, or unbroken granite. Beets will discolor after steaming if their preparation is not completed promptly.

It is important to use the proper type of can to avoid discoloration. For instance, products containing sulfur must be processed in C-enamel cans. If plain cans are used, the sulfur in the product combines with the metal in the can to form a tin sulfide, or iron sulfide. Although food thus discolored is not harmful when eaten it is unattractive in appearance.

Discoloration by oxidation may also be present in canned food when head space is too great, when the container is not properly filled with the medium, or when exhausting has been insufficient. This type of discoloration is not necessarily accompanied by spoilage. Occasionally beets, carrots, or sweetpotatoes may have darkened layers that are caused by drought, excessive heat, or other conditions which have retarded their growth. When growth is resumed the darkened layers are formed. Such a product is undesirable for canning because not only the color but the flavor is affected. Moreover, heat penetration is slower through the tough, woody portion that forms these layers and, therefore, the processing time given would be inadequate.

Scalding

Scalding is the heat treatment used for removing the peel from such produce as tomatoes and peaches. The fruit is placed in a wire basket and dipped into boiling water only long enough to heat the peel. The water must be boiling, because lower temperatures and longer scalding periods will soften the fruit instead of loosening the peel. Enough water must be used to maintain boiling temperatures when the produce is added and it must be changed frequently enough for cleanliness. A short, quick dip in cold water stops the heat treatment and shrinks the peel so that it can be removed easily. A cold spray may be used instead of the cold-water dip, but in either case the cooling should last only long enough to shrink or crack the peel on the fruit. Do not allow the produce to stand in the cold water, but drain and peel it at once.

Lye peeling

Sweetpotatoes, grapefruit, and some root crops may be peeled with the aid of lye. The lye used for this purpose is known commercially as caustic soda or soda lye (chemically, sodium hydroxide). It is inexpensive and at the same time most effective. The strength of the lye solution will vary with the kind of produce and the method of treatment. The lye acts most vigorously when hot and therefore should be kept at the boiling point. The amount of lye used can be kept to a minimum and the action of the lye can be made more effective if the produce is first dipped into boiling water for a few seconds to take the chill off. Do not expose the produce to the lye solution longer than for the period given in the processing instructions as the lye will attack the edible tissue and impair its quality and flavor.

Produce dipped in lye solution for peeling must be thoroughly washed. It is best to use slate or granite containers for lye solution. Do not use wooden containers. Because the solution continually acts upon the wood, such containers are difficult to clean and may be a source of contamination. Care should be exercised in preparing and using lye solution so that workers may not be burned or their wearing apparel damaged.

Where lye peeling is recommended, directions for its use are included in the processing instructions.

Steaming

Steaming is the heat treatment used to loosen skins before peeling root vegetables. This method is also used to break down or soften for pulping such produce as pumpkin, apples, and tomatoes. Steaming for peeling is done under pressure.

For peeling, steam only long enough to loosen the skin but not to cook the produce. Grade the vegetables for size when necessary, and adjust the time of steaming accordingly, in order to avoid uneven results. Produce that has been kept in storage will require a longer steaming than that which is fresh.

When steaming is done to soften the produce for pulping, use a steam-jacketed kettle or a retort. Produce should be of the highest quality and should be washed carefully and cut in uniform pieces for even steaming. Peels or rinds are usually left on since they are removed in the pulping process. If steaming is done in a retort, use galvanized-wire baskets, aluminum pans, or wooden slats to keep the product from coming in contact with the uncoated iron of the retort crate or the vegetables will become discolored.

Retorts used in the steaming process are operated in the same manner as when used for processing but cleaning will be necessary before they are used again for processing.

Pulping

Pulping or sieving is done to separate skins, seeds, cores, and fibrous material from the pulp of the steamed product. A pulping machine is desirable for

use where large quantities of produce are to be pulped. Small quantities may be pulped through hand-operated sieves. Work with these must be carried on rapidly in order to prevent oxidation of the product. When pulpers are fitted with a steam line, discoloration and oxidation can be kept to a minimum.

Reducing

Reducing is the process used to evaporate moisture from a pulped product or to evaporate liquid by heating it in a steam-jacketed kettle or similar container. It is desirable to reduce such products as pumpkin and squash for improved texture. The product is heated slowly until it reaches the desired consistency. It is desirable to reduce soup stock also to improve its flavor and to decrease the number of cans required.

Blanching

Blanching is a heat treatment given some products by immersing them in water at 180° to 200° F. and following with a cold dip or spray. The temperature that gives best results in blanching varies with the product. Steam blanching should not be used unless a thermometer is attached to the steamer to indicate the temperature of the steam. The main purposes of blanching are to decrease the volume of the product and to make it pliable in order to facilitate packing and to obtain a well-filled can. It also aids in driving the air and other gases from the plant cells.

In the case of peas and lima beans, blanching removes from the surface the sticky, gelatinous substance which, when present, might contribute to the increase of spoilage organisms. With some products, blanching removes objectionable raw flavors; with others, it fixes, or sets, the green color. Starchy products, such as peas, lima beans, or corn, take up water in blanching, thus reducing their swelling in the cans. With all products, blanching may be considered the final cleansing before the product is packed into cans. For that reason the blanching water must never be used as a canning medium. Blanching water must be changed often enough to insure its cleanliness and to prevent recontamination of produce by the accumulation of spoilage organisms.

Best results in blanching are obtained when baskets are filled from one-half to two-thirds full. Overfilling of baskets will result in an unevenly blanched product. Matting of the leafy products may be avoided by moving the basket back and forth through the blanching water. Continue blanching only long enough to obtain the desired texture and color change. Overblanching causes a loss of nutrients, color, and flavor and a softened or slimy texture of the product.

With most products blanching is followed with a cold dip of from 10 to 20 seconds. A spray may be used for this purpose instead of the cold-water tank, but in either case the cooling must be done quickly. The purpose of cooling is to stop the blanching process, separate the pieces of the product, and cool them enough to permit immediate packing. Do not start blanching if there is any reason for delay in completing the remaining steps of processing. Spoilage, including flat sour, occurs more rapidly after the produce is heated.

Preparation of containers

Cans must be inspected and cleaned before they are used. Post a chart near the storage place where cans are issued to show the type of container most suitable for a specific product. (See table 3, p. 38.) Issue cans to the patrons on the basis of the number required per bushel or other measure of produce that is to be canned. Table 4 on page 39 will help in computing the number of cans required for measured quantities of most fruits and vegetables. The number of cans required for the canning of meat may be estimated from table 13 on page 79. The supervisor should record the number of cans issued to each patron.

Just before filling, wash the cans in clean water. Soap should never be used in washing cans. Save unnecessary steps in the preparation of cans by using can trays. Do not wash can covers as this possibly may damage the gaskets. Instead, keep covers in cartons in which they were shipped to protect them from dust and moisture until they are to be used. They should be placed directly from the carton on the filled cans just before sealing.

Filling of cans

All products should be packed into cans immediately after preparation. Cans should be packed sufficiently full to assure well-filled cans after processing is completed. Slack filling may cause buckling and internal rusting of the cans. Overfilling slows heat penetration and may result in spoilage. Those products to which heat has been applied in preparation will spoil rapidly if left to stand at room temperature. If packed promptly while hot the time of exhausting to the recommended center-can temperature will be shortened. If fruits, such as peaches, pears, and apples, are left to stand after preparation, discoloration will occur. Some products, such as fruits and tomatoes, may be packed into cans as they are prepared. Pack them closely to obtain well-filled cans.

Use a scoop or similar equipment for pouring berries into cans to avoid unnecessary handling. Cans may be filled quickly with peas, snap beans, lima beans, or corn by using the can as a scoop and dipping it into the blanched product with one hand while using the other to press the product into place. Filling cans in this manner necessitates only one dip of the can into the product and permits filling at a much higher temperature than when done entirely by hand. Tap the bottom of the can lightly on the table to settle the product in it and to assure a firm pack. Sometimes it is necessary to add to the product or remove some of it after tapping in order to obtain the right head space.

Checking weight of can contents

In some instances it is desirable to check the drained weight of the produce that is packed into the can. This is the best way to prevent overfilling or underfilling. Most commercial packers follow this practice. It is particularly important that community canneries that can greens fill the cans by weight. After blanching greens, drain them for a short time to free them of excess water. Greens may then be packed directly into the can and weighed before adding the brine. Care must be taken not to exceed the recommended maximum drained weight. In weighing greens, allowance must be made for the weight of the can. The maximum and minimum drained weights for greens are given in the processing instructions.

Allowing for head space

Regardless of the method of filling it is important that proper head space be allowed. Head space is the distance between the level of the product in the can and the top of the can. It varies with the product and style of pack. For most products packed in liquid a ¼-inch head space is sufficient. The head space most satisfactory for each product is indicated in the canning instructions in this publication. In no case is it less than ¼ inch when a canning medium is used. When products, such as applesauce and pumpkin, are packed without medium, only enough head space is allowed to permit the sealing of cans as air space between the product and the can lid will cause discoloration of the top layer of food. Do not consider the canning medium in measuring or adjusting head space.

Adding canning medium

A canning medium (brine, sirup, or broth) is used to fill the cans completely after the produce has been packed to the proper head space. It is better to have some canning medium spill over when sealing the cans than to leave an air space between the product and the lid. The medium should be added at a boiling temperature to shorten the time for exhausting.

Brine is used as the canning medium for most nonacid products. In making brine, canners' salt is preferred since it dissolves faster and stays in solution better than table salt. It may be purchased from any salt manufacturer. Dairy salt may also be used. Iodized salt or any salt with a filler added to prevent lumping should not be used for canning. It is more economical to purchase a seasonal supply of salt at one time than to request patrons to furnish salt as needed. Store salt where it will stay clean and dry until it is used for brine. Impurities that will cause spoilage may be added through unclean salt. In making brine do not use water that is exceptionally hard or that contains an excessive amount of iron or other minerals. In some localities it may be necessary to preheat, settle, and filter the water to make it usable. To insure a uniform result, use a measured volume of water and weigh the salt in making each tank of brine.

Salt tablets and boiling water may be used instead of brine. Instructions for preparing brine and using salt tablets are given on pages 68–69.

Sirup is the canning medium used for most fruits and for sweetpotatoes except those packed solid. Table 9, listing the proportion of sugar to water, should be followed in making the various weights of sirup. Patrons should not use the time, equipment, or space necessary to make individual lots of sirup. It may be desirable to schedule the canning of fruit for a definite period of the day and request patrons to bring the amount of sugar that will be required for a sirup of the consistency desired. For example, if a medium-weight sirup is to be used, each patron should be requested to bring 5 pounds of sugar for each bushel of fruit to be canned.

When broth is used as the medium in canning meats it should be skimmed free of fat. It is usually made in a steam-jacketed kettle and dipped out for filling into cans.

Sirup and brine should be made in metal tanks provided for that purpose.

Exhausting

Exhausting is the heat treatment given to the produce after the cans are filled and before they are sealed. It has the following purposes:

(1) To expel air and other gases from the food cells and to remove air that may have formed in pockets between portions of food in filling cans. This process relieves the strain on can seams during processing and storing. If the air is not removed, it creates excess pressure during processing and cooling and may cause buckling of can ends with consequent straining of seams. Removal of air also prevents internal rusting and discoloration of tin which occur when the metal reacts to oxygen. (2) To secure a sealing temperature that will create an adequate vacuum in the can after processing is completed. (3) To complete the expansion or shrinkage of the product which assures a maximum fill without overfilling.

Some products, such as applesauce, pumpkin, squash, and cream-style corn, may not need to be exhausted because they are preheated before sealing. This is true if the recommended center-can temperature is maintained or exceeded. Instructions are given on page 32 for the operation of batch-type exhaust boxes used for exhausting produce.

Center-can closing temperature

The center-can closing temperature as referred to in this publication is the temperature of the can contents at the slowest heating point in the can at the time the can is sealed. Figure 65 shows how to take the center-can temperature of products that heat by convection and those that heat by conduction.

The slowest heating point in products that heat by *convection* is about halfway between the center and the bottom of the can. Products canned in a medium,

such as peas and beans in brine, and fruit in sirup, heat by convection.

The slowest heating point in products that heat by *conduction* is at the center of the can. Products such as pumpkin and squash, sweetpotatoes (solid pack), cream-style corn, and ground meat (solid pack) heat by conduction.

Center-can closing temperatures should be taken in a representative number of cans at various locations in the exhaust box before sealing is started. Keep the water in the exhaust box at the simmering point until all cans are removed and sealed to assure the proper center-can closing temperature.

Vacuum

In order to maintain the canned product in good condition it is necessary to have the proper vacuum. The ends of the cans should contract on cooling and remain slightly concave under average storage conditions. The vacuum produced after processing will vary with the average can temperature. The average can temperature is the temperature of the contents of the can obtained by thoroughly mixing it at the time of sealing. For products packed in a liquid medium in No. 3 cans, or smaller ones, the average can temperature should be at least 130° F. to assure the proper vacuum. For products packed in a liquid medium in No. 10 cans the product is usually exhausted to an average can temperature greater than 130° F. to prevent distortion of the can ends during processing. However, if the average can temperature is too great in No. 10 cans, the vacuum created may be so high that paneling may result during cooling due to the excess pressure on the outside of the cans. If the instructions for each product given in this publication are carefully followed, as to head space, exhausting to the recommended center-can temperature, sealing, and processing, sufficient vacuum will be obtained.

Initial temperature

The term "initial temperature" designates the temperature at the center of the can at the time the retort reaches processing temperature. Where an initial temperature is specified it should be regarded as a prerequisite of the process given for that product. The coolest can in any retort load should have an initial temperature equal to or greater than the temperature specified for that product. If a can is closed at the recommended center-can closing temperature and is then held for some time in the atmosphere of the room before it is processed, the initial temperature will be lower than the closing temperature. With those products for which initial temperature is specified in the processing table, it is the initial temperature and not the center-can closing temperature that is an important factor from the standpoint of sterilization.

To check the initial temperature, set aside the first two cans removed from the exhaust box and put on the covers but do not seal. When all cans to be processed together are sealed and placed in the retort take the center temperature of the cans that were set aside. This temperature will indicate the initial temperature of the batch at the time processing is started. In those instances where more than one initial temperature is given, the time for processing will vary with the initial temperature. For produce such as sweetpotatoes, pumpkin, and squash the higher initial temperature is recommended, as the processing period will be accordingly shorter.

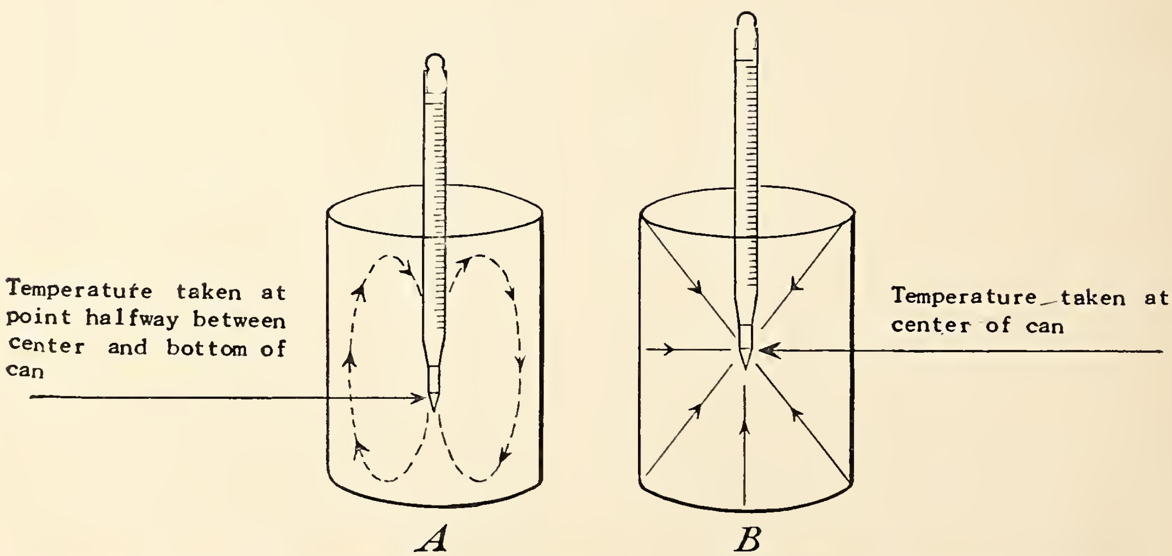

Figure 65.—Method of taking center-can closing temperature of: *A*, Products heated by convection; *B*, products heated by conduction.

Sealing

Sealing, or the permanent closing of the can, must be done as rapidly as possible following the exhausting of the product. Be sure that the sealer has been properly adjusted before sealing operations begin; otherwise there will be delays which may impair the quality of the product or cause spoilage. Check the sealer in accordance with instructions given on page 28. As cans are sealed an occasional inspection should be made to determine whether the sealer is in need of adjustment. Before sealing cans, press the contents down with a spoon to check for the proper head space. If the can is too full remove some of the produce. If it is necessary to add produce to get the recommended head space fill from a can that has been exhausted at the same time and is at the same temperature as the produce to be sealed. After adjusting head space, it may be necessary to add canning medium to fill the can completely and it should be added at boiling temperature. Be sure that there are no food particles on the rim of the can as these may prevent a perfect seal.

Marking cans

As cans are sealed, they are marked according to contents and ownership. This is usually done by the patron. If lids are marked before they are placed on the cans care must be taken not to stack them. Place a lid directly onto a can as it is lifted from the exhaust box for sealing. The use of a code to identify the product will simplify and expedite the marking of cans. String beans, for example, may be identified by the code SB, lima beans by LB. Community canneries should set up a code for all products canned. The code used should be the same throughout the season. Likewise the patron's number should be used rather than his full name. When marking cans it may be desirable to include the date for identification in the event of spoilage. This is particularly important when the patrons' numbers are issued on a daily or weekly basis.

Marking can be done with a soft lead pencil. Use the rubber of the pencil to roughen the space on the can that is to be marked. Marking can also be done with a water-steam-proof ink and a brush pen or rubber stamp. Individual rubber stamps for each product are desirable or a numbering machine fitted with letter and number bands may be used. The ink used should be free of phenol as it will cause an undesirable flavor in the canned food. Satisfactory inks and marking equipment may be obtained from companies listed on page 83. It is important that cans be free from grease when marked as ink will not stick to a greasy surface. For this reason when canning meats, it is advisable to mark the can lids before they are placed on the cans for sealing. Marking should be done rapidly so that sealing will not be delayed and the products be permitted to cool. Space should be provided on the sealing table for marking cans.

Stacking cans

Cans should be stacked in the retort crate in such a manner as to permit free circulation of steam among them. Heat penetration in canned foods packed in liquid is mainly by convection currents. The general trend of these currents is in a vertical direction. Consequently, in the products being heated they seek channels which permit such motion. If the products packed in liquid have been arranged to permit the free flow of convection currents and if cans are placed in the proper position in the retort, heat penetration will be facilitated. Where the packing of any product in the can results in stratification as in the case of No. 10 cans of spinach, cans should be placed on their sides in the retort to permit the free flow of convection currents through the stratified layers. In the case of asparagus spears which are packed parallel in the cans in a vertical position, the channels containing liquid are parallel to the spears and the speed of heat penetration is greater when the cans are placed upright in the retort. For products such as peas and cut green beans the rate of heat penetration is not so affected by the position of the cans in the retort because the pieces are small and evenly distributed throughout the liquid medium.

Cans should not be placed directly on top of one another but should be "staggered" to allow for rapid and complete circulation of steam which will aid in eliminating air from the retort. Solid or insufficiently perforated metal retort crates should not be used because such equipment can lead to the formation of low-temperature regions. Where slatted retort crates with perforated metal bottoms are used, it is well to place a wire rack under the cans to permit the free flow of steam through the perforations and up through the retort load.

Processing

The term "processing" as used in this publication designates the heat treatment expressed in terms of temperature and time given the product after the container is permanently sealed. The basic or minimum requirement for the processing of any product is that it be heated sufficiently to destroy bacteria of known resistance to heat, which if not destroyed may cause serious illness (see p. 59). There are also types of heat-resistant micro-organisms which may cause spoilage if the product is contaminated with them. Consequently, the efficiency of any process must be such that all micro-organisms are rendered harmless. In some cases the count of spoilage bacteria may be so high that the suggested processing may be inadequate to prevent spoilage. It is, therefore, essential to keep the bacterial count as low as possible by following approved methods in the preparation of food products.

In the processing of canned foods it is always assumed that the heat-resistant micro-organisms will be located at the slowest heating point of the can contents. Until this point has received adequate heat, the contents of the can are not sterilized suf-

ficiently to control the bacteria. Processing times are partly based on the rate at which heat is transferred to this point. It is transferred from the walls of the container to the contents by both convection and by conduction. In the heating of canned foods packed in liquid, such as peas, snap beans, and beets, heat transference takes place mainly by convection and the rise in temperature is rapid since there is constant movement of the material so that at any time during the heating temperature differences within the can are small. Any substance which retards convection currents decreases heat transference.

Solid foods heat by conduction and the process is relatively slow since there is no transfer of material from the hot to the cooler part of the can. In produce that heats slowly, such as pumpkin, squash, and sweetpotatoes (solid pack), the initial temperature is part of the process as it determines the length of processing time that will be required to make the product keep safely (see p. 56). Both methods of heat transference occur in tomato juice and fruit juice containing pulp and therefore longer processes are required than for clear, strained juices from which the particles are removed.

Depending on the nature of the product, processing should follow within ½ to 1 hour after sealing. If a longer time is required to obtain enough cans to fill a retort, processing of partial retort loads should be practiced. The use of pressure canners for processing small amounts of produce is a practical solution to this problem.

Water-bath processing

The boiling-water process is used for acid products, such as fruits, tomatoes, and sauerkraut, as the temperature obtained (212° F.) is sufficient to kill all actively growing bacteria and yeasts and the acid in the food prevents the growth of any heat-resistant spores that may be present. Fruit juices free from pulp can be preserved by pasteurizing them in water at 180° F. for 20 minutes provided they are filled into clean cans while hot. Tomato juices which contain considerable pulp must be processed in the boiling-water bath. The time for processing acid products is given in the instructions for each product and in table 10 (page 69). Instructions for operating the open-process tanks used for water-bath processing are given on page 24. These instructions should be carefully followed.

The temperature of boiling water varies with the altitude, and it is necessary, therefore, to make corrections in length of processing times at elevations above sea level. When using the boiling water-bath process at altitudes higher than sea level, add 1 minute for each 1,000 feet when the processing time is 20 minutes or less; 2 minutes for each 1,000 feet when the processing time is longer than 20 minutes. The longer processing time required to compensate for the lower temperatures at which water boils at altitudes above sea level must be observed if actively growing bacteria are to be destroyed and spoilage prevented.

Steam-pressure processing

The steam-pressure process is used for all nonacid vegetables, meats, and fish. In processing such products the complete elimination of air from the retort or pressure canner is a vitally important factor; otherwise, the temperature will be lower than that required for sterilizing the products. (Instructions for operating these pressure vessels given on pp. 16–19 and 42–44 should be carefully followed.) A minimum temperature of 240° F. is necessary to destroy the heat-resistant spores of bacteria that may be present. Although 240° F. will assure a safe product when processing greens, such as spinach, chard, or turnip tops, a temperature of 252° F. is recommended in order to cut down the processing time and to obtain a product of better quality. The time for processing nonacid products at specified temperatures must be carefully observed if spoilage from underprocessing is to be prevented. If at any time during the processing period the temperature drops more than 5° below that specified, the produce should be given a complete new cook, starting from the time the retort is brought back to the specified processing temperature. Should there be a temperature drop of from 1° to 5°, 2 minutes should be added to the cook for each minute that the temperature registered below the processing requirements. For example, if there were a 4° drop for 10 minutes it would be necessary to add 20 minutes to the normal processing time. Furthermore, if products must be reprocessed for any reason, such as failure of cans to seal, or excessive buckling that causes a break in the can seam, such products must be reprocessed promptly in new cans for the full time at the temperature given in the processing instructions for that product. The time for processing nonacid products is given in the instructions for each product and in tables 12 and 14 (pp. 78 and 83). When processing

TABLE 8.—*Gage pressure corresponding to specified processing temperatures at various altitudes*

Temperature ° F.	Sea level	Feet above sea level—							Temperature ° C.
		500	1,000	2,000	3,000	4,000	5,000	6,000	
200	----	----	----	----	----	----	----	----	93. 3
205	----	----	----	----	----	----	0. 5	0. 9	96. 1
210	----	----	----	0. 4	0. 9	1. 4	1. 8	2. 3	98. 9
212	0. 0	0. 2	0. 5	1. 0	1. 5	2. 0	2. 4	2. 9	100. 0
215	0. 9	1. 1	1. 4	1. 9	2. 4	2. 9	3. 3	3. 8	101. 7
220	2. 5	2. 7	3. 0	3. 4	3. 9	4. 4	4. 9	5. 3	104. 4
225	4. 2	4. 5	4. 7	5. 2	5. 7	6. 2	6. 6	7. 1	107. 2
230	6. 1	6. 3	6. 6	7. 1	7. 6	8. 0	8. 5	9. 0	110. 0
235	8. 1	8. 3	8. 6	9. 1	9. 6	10. 0	10. 5	11. 0	112. 8
240 [1]	10. 3	10. 5	10. 8	11. 3	11. 7	12. 2	12. 7	13. 1	115. 6
242	11. 2	11. 4	11. 7	12. 2	12. 7	13. 1	13. 6	14. 1	116. 7
245	12. 6	12. 9	13. 1	13. 6	14. 1	14. 6	15. 0	15. 5	118. 3
248	14. 1	14. 3	14. 6	15. 1	15. 6	16. 0	16. 5	17. 0	120. 0
250	15. 1	15. 4	15. 6	16. 1	16. 6	17. 1	17. 5	18. 0	121. 1
252 [1]	16. 2	16. 4	16. 7	17. 2	17. 7	18. 1	18. 6	19. 1	122. 2
255	17. 8	18. 1	18. 3	18. 8	19. 3	19. 8	20. 2	20. 7	123. 9
260	20. 7	21. 0	21. 2	21. 7	22. 2	22. 7	23. 1	23. 6	126. 7

[1] In community canneries where thermometers are not installed on retorts and gages are used as guides in processing, it is important that a pressure of 10.3 pounds be maintained in order to assure a temperature of 240° F. and a pressure of 16.2 pounds for a temperature of 252° F.

with steam pressure at altitudes higher than sea level it is necessary to increase the pressure approximately one-half pound for each 1,000 feet to attain the required temperature. Table 8 shows the gage pressure that corresponds to specified temperatures at various altitudes.

Cooling

Cooling of cans should follow immediately after processing is completed to prevent overcooking of the food. All acid products canned by the water-bath method and most nonacid products packed in No. 3 cans, or smaller ones, can be successfully water-cooled or air-cooled. Nonacid products such as greens processed at 252° F. may need to be cooled under pressure. All nonacid products canned in No. 10 cans must be cooled under pressure; otherwise the ends of the cans may buckle when the steam pressure is permitted to drop after the cooking is completed. For instructions on cooling cans under pressure, see page 18. In cooling acid products and those nonacid products not requiring pressure cooling, cold running water should be used whenever possible. Only pure water should be used for cooling since the contraction of the can as the vacuum is produced may draw water into the can. If there are impurities in the water, spoilage may result. The duration of the water-cooling period should be sufficient to bring the temperature of the contents to 100° F. This temperature is low enough to prevent the growth of thermophilic bacteria and still high enough to dry the can and prevent rusting. Cans should be placed where cooling may be completed rapidly by air circulation. If the capacity of the water-cooling equipment is inadequate or if a shortage of water is experienced, cans should be stacked so that they will air-cool rapidly. In this case cans should be stacked on their sides in single rows and space should be allowed for air circulation between rows. The cans should be arranged parallel to the cross ventilation of the room. Careful attention to the factors affecting air circulation may serve to prevent retarded cooling and to safeguard against spoilage by thermophilic bacteria. If cans are stacked before they are completely cooled there may be enough heat left to cause stack burn and flat sour spoilage in those at the center of the stack. For the same reason cans should not be placed in cartons or stacked in baskets, for removal from the cannery, until they are completely cooled.

Storage

Patrons should be advised to place their canned foods in a dry, well-ventilated space. The temperature should be as near constant as is possible and moderately cold but not freezing. Avoid storage space near steam pipes, radiators, or stoves, as high storage temperatures may impair the flavor, texture, and color of the canned products and the excessive moisture will cause the cans to rust. Patrons should be encouraged to report spoilage in order that its cause may be determined and future losses from spoilage be prevented.

Spoilage

Spoilage in canned foods may be due to allowing produce to stand too long during the period of preparation, to leakage through a faulty closure, or to underprocessing. Bacteria present the most serious problem in canning because of the large number of kinds and the wide range of temperatures at which they grow. Some are easily killed while others form heat-resistant spores. Certain of these spores can survive many hours in boiling water and make necessary the severe cooking given to nonacid foods. If for any reason foods are underprocessed the bacterial spores present may grow and spoilage will result. Molds are destroyed with comparatively little heat and are present only when processing has been insufficient, or when there is a faulty seal through which the fungi may enter the can. Food on which mold grows becomes less acid and therefore favors the growth of bacteria that would not develop in an acid medium. Yeasts also are destroyed at relatively low heat. They grow most favorably where sugar and acid are present and cause spoilage by the production of alcohol and gas. Spoilage is not always indicated by the appearance of the can or of its contents. This is particularly true in the case of flat-sour spoilage and may be true of botulinus spoilage.

Some of the common types of spoilage with which canners have to contend are as follows:

Flat-sour

Souring in canned products is caused by the action of the thermophilic (heat-loving) bacteria which grow most favorably at temperatures from 100° to 145° F. A can that contains sour products and that shows no evidence of swelling is known as a flat-sour. Thermophilic bacteria form extremely heat-resistant spores and if these are present in any number the processes recommended are inadequate to destroy all of them. Spoilage due to these bacteria is usually indicated by a sharp sour odor and flavor, and a cloudy liquor. There is no indication that spoilage has occurred until the can is opened. This type of spoilage may develop either during storage at high temperatures or at any stage in the canning process when the product is allowed to remain at a temperature favorable to the growth of flat-sour bacteria. It often occurs when cans have not been sufficiently cooled after processing.

Botulinus

Bacillus botulinus, a spore-forming bacterium, is present in most soils and may be present in any food. These organisms cannot be completely removed by washing. The bacteria themselves are not harmful and we eat them every day in our fresh foods. However, when these bacteria are sealed in a can of nonacid food and the can is not properly processed, the spores of the bacteria will grow. These spores grow best at temperatures ranging between 50° and 100° F. and only in the absence of oxygen. Underprocessed

nonacid foods kept under average storage temperatures provide perfect conditions for the growth of botulinus spores. The spores are heat-resistant and can survive for long periods of time in boiling water. It would be necessary to boil nonacid foods, such as beans, corn, peas, meats, and fish, for from 6 to 10 hours or even longer to accomplish a 100-percent kill. Obviously it is impossible to process these foods for such a length of time and also preserve their flavor, color, and nutriment to the highest degree. A shorter period of time for the destruction of these dangerous botulinus spores is made possible only by processing under pressure. However, if underprocessing occurs due to inadequate venting of retorts or pressure canners, or if there is failure to maintain the temperature for the specified time for processing each of these products, the spores may grow and produce toxin. This toxin is one of the most poisonous substances known.

There may be almost no evidence of spoilage when the toxin produced by *Bacillus botulinus* is present. Boiling the canned food will usually indicate this spoilage by a bad or "off" odor. Boiling the food for 10 minutes will destroy the toxin in all vegetables except corn and spinach. They should be boiled for 20 minutes. Any food suspected of being spoiled should be destroyed. Botulinus spores will not grow in an acid medium. Therefore, acid foods such as fruits and tomatoes may be safely processed in boiling water (212° F.). Although the spores do not grow in an acid medium they are still alive and if this medium should be changed in any way, such as the destruction of acid by the growth of mold, they may be able to develop and liberate toxin. For this reason it is advisable never to use any canned food which shows signs of mold growth.

Swells

"Swells" is a term applied to cans when the ends are bulged. This condition may also be referred to as "flippers" or "springers," the latter term being used when the cans show bulging at only one end. The gas produced by the spoilage of the can contents may result from the growth of bacteria that are present in underprocessed foods or of those that have entered the can through a faulty seam. If swelling occurs in cans that have a good vacuum after processing is completed and have no defects in the seams, it is the result of underprocessing. Swells from underprocessing sometimes develop in a few days but often spoilage may be delayed for weeks or even months. There is an objectionable sour odor with this type of spoilage and a darkening of the product from the action of the gas.

Hydrogen springers

Hydrogen springers or hydrogen swells are cans that contain hydrogen gas produced by the reaction of the food product with the metal of the can. Swells due to this chemical action as a rule develop more slowly than those that result from bacterial growth and there is no odor to the gas produced. The product may look normal or somewhat bleached in appearance but will have no further indication of spoilage. Hydrogen springers may develop when colored products, particularly red ones, have been canned in plain tin or in enamel cans that have been damaged through careless handling or sealing.

Stack burn

Stack burn results from placing warm cans in stacks or cartons where the circulation of air is not adequate to complete the cooling process rapidly. The product consequently softens and darkens and may become caramelized.

Foreign flavors

Foreign flavors in canned foods are usually acquired before the product is packed into cans. The acquired flavor may be due to the use of unclean crates for harvesting the product or to undesirable storage conditions. Fruit is very likely to take up flavor from long storage in wooden boxes. Any produce acquires a foreign flavor quickly when held in cold storage where there is little ventilation or when permitted to remain in containers until mold develops.

Disposal of spoiled foods

Always play safe. Do not give people, animals, or poultry a chance to taste spoiled canned food. Burn food that is spoiled, or, with a stick stir several spoonfuls of lye into the can of spoiled food and let it stand 24 hours—safely out of the reach of children or pets. Then bury the food, lid, can, and stick.

Canning instructions

The instructions given in this publication for processing both acid and nonacid foods have been adapted from commercial canning practices and are based on suggestions made by the National Canners Association. They are intended as a guide for community canneries that use tin containers. If it is necessary to use glass jars it is recommended that their use be limited to the canning of acid products by the water-bath method.

These processes, it must be kept in mind, are designed for use in plants where the quality of the produce canned, the equipment used, plant sanitation, and supervision are carefully controlled. The processes are adequate for community canneries where the conditions of operation and supervision meet the standards that have been suggested.

All processing times are based on temperatures at sea level. Altitude adjustments will need to be made in accordance with instructions given on page 58.

Canning fruits, tomatoes, and other acid foods

Fruits, tomatoes, and other acid foods are processed in a water bath at 212° F., the temperature of boiling water at sea level. This temperature is sufficient to kill all actively growing bacteria and yeasts and the acid in the food prevents the growth of any heat-resistant spores that may be present. Read carefully the discussion on canning procedures for acid foods, page 58.

Fruits may be canned with or without sugar. Cane and beet sugars are equally good for sweetening food. Table 9 gives the proportion of sugar and water for various densities of sirup.

TABLE 9.—*Proportions of sugar and water for sirups*

Percentage of sugar	Consistency of sirup	Sugar needed per gallon of water			
		Lbs.	*Ozs.*	*Cups*	*Qts.*
20	Light	2	2	5	1¼
30	Moderately light	3	10	8	2
40	Medium	5	9	12½	3⅛
50	Moderately heavy	8	6	19	4¾
60	Heavy	12	8	28	7

Prepare sirup in advance of the time it is to be used. Boil the sugar and water together for 5 minutes to dissolve the sugar and remove the air from the sirup. Skim off any scum that forms on top. The sirup should not be boiled longer than the time specified because the water will evaporate and the desired consistency will not be obtained. Reheat to boiling point before filling cans.

The quantity of sugar needed may be estimated from table 9. From ¾ to 1 cupful of sirup should be allowed for each No. 2 can of fruit.

All fruits and fruit juices can be successfully canned without the use of sugar. For jelly making, pie filling, or for salads, such fruits serve very well. Fruit canned without sugar is not nearly so good for sauce as fruits sweetened when canned. The use of sugar helps to preserve the color, texture, and flavor of the fruit.

Apple butter

Container.—Use plain cans.

Quality of produce.—Poorly shaped or windfall apples of good flavor may be used for making apple butter. The fruit should be fully ripe and sound, that is, free from rot, mold, bruises, worm holes, and disease. Dry or withered apples should not be used. The trimmings, such as parings and cores, of canning apples may also be used in the preparation of apple butter.

Preparation.—Wash apples thoroughly to remove dust and spray residue. Cut away any bruised portion or blemishes. Section the apples, and remove the blossom and stem ends. Cook apples slowly until soft in a steam-jacketed kettle or steamer. Only a small amount of water is needed for steaming. Run steamed apples through a pulper or sieve to remove skins, cores, and seeds. One bushel (50 pounds) of apples will produce from 8 to 10 gallons of pulp. The following basic formula may be used; spices and sugar may be varied as desired:

- 10 gallons apple pulp
- 10 gallons cider
- 3¼ tablespoonfuls ground cinnamon
- 1¾ tablespoonfuls ground allspice
- 15 pounds sugar (granulated or brown)
- 1½ tablespoonfuls ground cloves

Heat the 10 gallons of cider until it is reduced to about 3 gallons. Cook the apple pulp in a steam-jacketed kettle, stirring frequently to prevent scorching. Add the reduced cider after the pulp begins to thicken. Sugar is added with the cider. Brown sugar adds to the flavor of apple butter. Continue cooking until the product has been reduced to approximately 45 percent of its original volume. Spices should be mixed together in a small amount of cold water and added to the butter 10 minutes before cooking is completed. Spice that is added dry will cause lumps and, when cooked too long, will lose flavor. Apple butter is sufficiently cooked when liquid does not separate after a spoonful is dropped on a saucer.

Filling.—Fill cans with hot apple butter to within ⅛ inch of the top.

Exhausting.—It is not necessary to exhaust apple butter that is filled into cans and sealed at the temperature of 190° F.

Sealing.—Seal cans at once and place in open process tank.

Processing.—Process No. 2, No. 3, or No. 10 cans in boiling water (212° F.) for 10 minutes.

Cooling.—Immediately after processing is completed cool cans as rapidly as possible to approximately 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. When the cans are removed from the cooling water they should be tilted, to drain off excess water, and they should be stacked in a well-ventilated place until cold. Do not put them into cartons until they are cold and dry.

Apples in sirup

Container.—Use plain cans.

Quality of produce.—Apples for canning should be of good flavor and color and have a firm texture. Those with white flesh and high acidity give the best flavor. Apples should be free from rot, bruises, and worm infestation. For uniform texture and appearance varieties should be kept separate.

Preparation.—Wash apples carefully to remove all traces of dirt and spray residue. Apples may be pared and cored by machines or by hand; in canning large quantities it is preferable to use paring machines. Trim off any blemishes from pared apples and dip the apples at once in a 3-percent salt solution (4 ounces of salt to 1 gallon of water) to prevent discoloration. Slice apples into quarters or eighths using a stainless steel knife or apple slicing device.

Soaking.—Soak sliced apples in a 3-percent salt solution to remove as much oxygen as possible, if the canned product is to be held over a period of several months. If this is not done, the oxygen in combination with the acid of the apples will develop springers

and cause perforations in the containers. The hard varieties of apples should be soaked for 20 minutes in the salt solution at 130° F. Soft varieties should be soaked for 20 minutes in the salt solution at room temperature (70° F.). Remove apples from salt solution and wash thoroughly. Any salt left in the apples may also develop springers and cause perforations in the containers. If apples are to be used within a few months it is not necessary to soak them in the salt solution.

Blanching.—Blanch apples by placing slices in a wire basket and immersing in hot water at 180° to 200° F. until the slices are pliable but not soft. The blanching time varies with the variety of apples. Dip blanched apples in cold water and remove them immediately.

Filling.—Fill apples into cans immediately after blanching. Press the slices into the cans as closely as possible without crushing them. Fill to within one-fourth inch of the top of cans. Add boiling sirup or water to completely fill the cans. A light sirup made in the proportions given in table 9 is generally used.

Exhausting.—Exhaust apples to a center-can temperature of 190° F.

Sealing.—Seal cans as soon as the exhaust temperature is reached.

Processing.—Process No. 2, No. 3, or No. 10 cans of apples in boiling water (212° F.) for 10 minutes.

Cooling.—Immediately after processing is completed, cool the cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not put cans in cartons until they are cold and dry.

Applesauce

Container.—Use plain cans.

Quality of produce.—Applesauce of good quality may be made from small, poorly shaped apples if they are sound and of good flavor. Any apples to be used must be free from mold, bruises, and worm holes.

Preparation.—Wash apples carefully to remove all traces of dirt and spray residue. Apples for sauce need not be pared. Cut away blemishes and bruised portions and remove cores and stem and blossom ends. Trim carefully to assure applesauce of desirable flavor and color. Applesauce made with unpared apples will be of a darker color than that made from pared apples. If a light applesauce is desired pare the apples and quarter or grind for steaming.

Precooking.—Use a steam-jacketed kettle or large stockpot for steaming apples. Cook only long enough to soften apples. Put the unpared apples through a pulper or sieve to remove the skins. Pared apples that have been quartered or ground need not be sieved. The quartered, pared apples will make a lumpy applesauce, suitable for pies. Add one cupful of sugar for each gallon of apple pulp. Heat to boiling point (212° F.).

Filling.—Fill boiling applesauce into cans leaving only enough head space to allow for placing a lid on the can.

Exhausting.—It is not necessary to exhaust applesauce if it is filled into cans at boiling temperature and sealed immediately. To insure a high closing temperature, cans should not be filled faster than they can be sealed.

Sealing.—The sealing temperature should not be below 190° F. Do not permit cans to cool before processing.

Processing.—Process applesauce, in boiling water (212° F.), as follows:

Size of can:	*Minutes*
No. 2	10
No. 2½	15
No. 3	15
No. 10	20

Cooling.—Immediately after processing is completed, cool the cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. When the cans are removed from the cooling water they should be tilted to drain off excess water, and stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Apricots

Container.—Use plain cans.

Quality of produce.—Use apricots that are fully ripe but firm. Be careful to avoid bruising fruit in handling or in transportation.

Preparation.—Remove green, overripe, bruised, or defective fruit. Wash thoroughly. Apricots may be canned in four ways—as pitted halves unpeeled, pitted halves peeled, whole unpeeled, and whole peeled. For peeling, dip the apricots into boiling water for about 1 minute, then plunge them into cold water and peel. Halve and pit after peeling. If desired, one or two pits may be added for flavor to each can of pitted apricots.

Filling.—Fill cans to within one-quarter inch of the top. Pack halved apricots in overlapping layers, pit side down. Fill cans completely with boiling sirup. Use a medium sirup made in the proportions given in table 9.

Exhausting.—Exhaust apricots to a center-can temperature of 160° F.

Sealing.—Seal cans immediately after removal from the exhaust box. Do not permit cans to cool before processing.

Processing.—Process apricots in boiling water (212° F.), as follows:

Size of can:	*Minutes*
No. 2	25
No. 2½	35
No. 3	35
No. 10	40

Cooling.—Immediately after processing is completed, cool the cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. When the cans are removed from the cooling water they should be tilted, to drain off

excess water, and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Berries [2]

Container.—Use R-enamel cans.

Quality of produce.—All berries should be canned as soon as possible after picking. They should be ripe but firm and free from mold or other signs of spoilage. Berries cannot be held long without a high percentage of loss. They should be harvested and transported in shallow, well-ventilated crates to avoid heating or mold.

Preparation.—Sort berries to remove green, overripe, or defective fruit, and leaves, stems, or other foreign material. Blackberries, dewberries, loganberries and raspberries should be placed in shallow layers in a large colander or small-mesh wire basket and washed under gentle sprays of water, or they may be dipped up and down gently in water to remove dirt and foreign material. Do not let berries stand in water; remove them as soon as they are clean. To wash blueberries and huckleberries, immerse them in a sufficient quantity of water to float leaves or foreign material that may be present. This will expedite handling.

Filling.—Fill berries into cans to within one-quarter inch of the top, packing them as closely as possible without crushing the fruit. Fill cans completely with boiling sirup. Use a medium sirup made in the proportions given in table 9.

Exhausting.—Exhaust berries to a center-can temperature of 170° F.

Sealing.—Seal cans immediately after removal from the exhaust box. Do not permit cans to cool before processing.

Processing.—Process berries in boiling water (212° F.), as follows:

Size of can:	*Minutes*
No. 2	15
No. 2½	20
No. 3	20
No. 10	25

Cooling.—Immediately after processing is completed, cool the cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Cherries, sour

Container.—Use R-enamel cans.

Quality of produce.—Sour cherries should be fully ripe so that the full color and flavor are developed. They are generally picked without stems and should be canned promptly to prevent loss from contamination or mold.

Preparation.—Sort to remove wormy, bruised, overripe or underripe fruit and foreign material. Wash thoroughly to remove dirt or spray residue and let them stand in cold running or iced water sufficiently long to chill them thoroughly. This will make them more plump and easier to pit. It will also facilitate the removal of wormy fruit which usually floats. When thoroughly chilled, pit. Pitting may be greatly facilitated by the use of a cherry-pitting machine.

Filling.—Fill pitted cherries into cans to within one-fourth inch of the top, pressing cherries down to assure a full pack. Add boiling water or sirup to fill the can completely. A medium, moderately heavy, or heavy sirup may be used and should be made according to the proportions given in table 9.

Exhausting.—Exhaust cherries to a center can temperature of 170° F.

Sealing.—Seal cans immediately after removal from the exhaust box. Do not permit cans to cool before processing.

Processing.—Process cherries in boiling water (212° F.), as follows:

Size of can:	*Minutes*
No. 2	15
No. 2½	20
No. 3	20
No. 10	30

Cooling.—Immediately after processing is completed, cool the cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Cherries, sweet

Container.—Use plain cans for the light-colored cherries and R-enamel cans for the dark-colored cherries.

Quality of produce.—Cherries should be ripe but firm and should be canned while they are fresh. Fruit showing bruises or signs of rot should not be used.

Preparation.—Discard bruised, overripe, underripe, rotten, or otherwise inferior fruit. Remove leaves, stems, and other foreign material. Wash thoroughly. If cherries are to be pitted they should be thoroughly chilled first to prevent loss of juice in pitting. Pricking helps to prevent splitting of the unpitted cherries during processing.

Filling.—Fill cherries into cans to within one-fourth inch of the top, packing them as closely as possible without crushing the fruit. Add boiling sirup to fill the cans completely. Use a medium or light sirup made in the proportions given in table 9.

Exhausting.—Exhaust cherries to a center-can temperature of 170° F.

Sealing.—Seal cans immediately after removal from exhaust box. Do not permit cans to cool before processing.

Processing.—Process cherries in boiling water (212° F.), as follows:

Size of can:	*Minutes*
No. 2	15
No. 2½	20
No. 3	20
No. 10	30

[2] Strawberries are better in jam or as a preserve than as a plain canned product.

Cooling.—Immediately after processing is completed, cool the cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and prevent rusting. When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Fruit juices

Container.—Use R-enamel cans.

Quality of produce.—Use only sound, well-ripened fruit for juices. Grapes, black and red currants, blackberries, elderberries, cherries, and plums may be used for making fruit juices.

Preparation.—Work with only such quantities of fruit as can be processed promptly. Wash the fruit, drain, and crush. Remove the seeds from cherries before crushing as seeds change the flavor of the juice. Add water, if desired, to thin the juice—about one-half cupful to each pound of fruit except to berries, which require no water. Heat slowly to 170° to 180° F. and hold for several minutes, or until the juice can be separated from the pulp. To avoid overcooking and to preserve as much as possible of the original flavor and color, check the temperature with a thermometer as the fruit is precooked and the juice is pasteurized. Strain through a double thickness of cheesecloth or put in a fruit press to extract the juice. If a fruit press is used avoid crushing the seeds of berries. Crushed seeds will change the flavor of the juice. A second straining without pressure makes the juice clearer. Sugar helps to preserve color and flavor but it may be omitted. If desired, add sugar, about ½ to 1 cupful to a gallon of juice. Heat the juice to 160° to 170° F.

Filling.—Fill the cans to the top with the hot juice.

Exhausting.—It is not necessary to exhaust fruit juices if filled into cans at a temperature of 160° to 170° F.

Sealing.—Seal at once and place in open process tank.

Processing.—Process No. 2, No. 2½, or No. 3 cans of clear fruit juice at simmering point (180° F.) for 20 minutes. This processing is not safe for fruit juices that contain pulp.

Cooling.—Immediately after processing is completed, cool the cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Grapefruit

Container.—Use plain cans.

Quality of produce.—In order to obtain a canned product of good quality it is best not to can grapefruit until it has reached a full-ripe stage. The longer the fruit is allowed to hang on the tree the less acid and less bitter will be the final product. Fruit with skin blemishes is satisfactory but that which shows any signs of decay should be discarded. Grapefruit may be stored a week or more before processing if kept in a cool well-ventilated place. Removal from a cold storage room to a warm, humid atmosphere will cause sweating which may promote decay of the fruit. Such fruit should be processed the same day or spread out to dry.

Preparation.—Grapefruit prepared in small quantities is usually peeled by hand. Cut off both ends to the depth of the peel but not deep enough to open the segments. Slit the remaining peel parallel with the center at points corresponding to quarters, sixths, or eighths. Tear off the peel, taking as much of the white membrane as possible. Most of the bitterness of grapefruit comes from the white membrane which must be removed if a product of good quality is to be obtained. When working with large quantities of grapefruit it may be desirable to peel them with the aid of a lye solution. If a lye solution is used the grapefruit should be slightly underripe. The whole fruit is placed in boiling water for 3 to 6 minutes or a sufficient length of time to loosen the outer or yellow peel from the deeper layers of the white membrane, then by quarter scoring the rind as in hand peeling the peel can be readily removed, leaving only a thin layer of the white membrane on the outside of the fruit or juice cells. This membrane is then removed by passing the fruit through a solution of boiling lye (caustic soda). The principle is the same as in the removal of skin from peaches. The lye solution used is prepared by dissolving 1½ to 3 ounces of granulated lye in 1 gallon of water. It must be kept boiling. The time of submersion is usually 25 to 35 seconds. The fruit is then washed thoroughly in a cold water bath or beneath cold water sprays of sufficient force to wash off the particles of membrane as well as all traces of the lye. Separate the grapefruit into halves, working from the bloom end and being careful not to break the juice cells more than necessary. A wooden or bamboo knife or a dull case knife is used for this purpose and for separating the segments. Working with one-half of the grapefruit, insert the knife blade just under the covering membrane of the top segments. Push the knife outward and loosen the membrane at the rind edge. This leaves the top membrane free except at the center. Loosen any outside membrane at the rind, then remove the seeds, working toward the center. Insert the knife below the section near the center and push outward lifting the section from its membrane. Continue the operation until all segments are removed. The segments are placed in aluminum pans or packed directly into cans.

Filling.—Pack segments of grapefruit closely into No. 2 cans to within one-fourth inch of the top, keeping the rounded side of the segment to the side of the can. Add a medium or moderately heavy sirup, made according to proportions given in table 9, to fill the can completely. To permit the sirup to flow more freely into the space between the segments insert a knife down next to the side of the can. Some prefer to put a small amount of sirup in the can before packing the segments. This assures an even distribution of sirup throughout the can.

Exhausting.—Exhaust grapefruit slowly to a center-can temperature of 160° F.

Sealing.—Seal cans immediately after removal from the exhaust box. Do not permit cans to cool before processing.

Processing.—Pasteurize No. 2 cans in a water bath of 180° F. for 10 minutes. This should give a center-can temperature of 165°. Use a thermometer to check the temperature of the water bath, taking care to keep it at 180° throughout the pasteurizing period. A higher temperature will cause a softening of the fruit and will destroy the natural fruit flavor; a lower temperature may result in spoilage. It is desirable to have the water at 200° when the cans are added.

Cooling.—Immediately after processing is completed, cool the cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Peaches

Container.—Use plain cans.

Quality of produce.—Select peaches that are fully ripe but firm. Peaches for canning should be slightly less ripe than for eating fresh. Soft fruit should be used for butter or preserves. Use care to avoid bruising fruit in handling or in transportation.

Preparation.—Remove green, overripe, or defective fruit. To peel freestone peaches,[3] place them in a blanching basket and dip into boiling water for approximately 1 minute or until the skins slip easily. The blanching time will vary with the ripeness of the fruit. Water under boiling temperatures will cook rather than loosen the skin of peaches. Remove from boiling water and dip into cold water to stop the peaches from heating and to loosen their skins. Do not permit peaches to stand in cold water. Slip off skins, cut peaches in halves, and discard the pits. Peaches may be canned either as halves or slices. If desired, one cracked pit may be added to each can, for flavor.

To peel clingstone peaches, or freestone peaches if large quantities are to be handled, dip them into a boiling lye solution for 15 to 30 seconds. The solution is made by adding from 1½ to 4 ounces (approximately 1½ to 4 tablespoonfuls) of a standard brand of granulated lye (caustic soda) to 1 gallon of water. The lye solution may be prepared in the enamel or slate-type sinks often used in community canneries for blanching. Leave peaches in the lye solution long enough to loosen but not to remove the skins. If a large quantity of peaches is being handled at the cannery in any one day, peeling by the lye method can be expedited if the peaches are halved and pitted first and dipped in hot water long enough to heat the surface. This lessens the quantity of lye required, makes the period of contact shorter and the attack on the peaches shallower. Precaution should be taken not to let the peaches stand in the solution longer than the period designated or the product will absorb the solution to such an extent that the flavor will be impaired. Transfer to a tank of cold water, raise and lower the basket several times, and shake slightly. Repeat the procedure in a second tank of cold water. This should wash the lye off the peaches and remove the skins. Then proceed as for freestone peaches.

If it is necessary for peaches to stand any length of time after peeling and before filling into cans, discoloration may be prevented by dipping the fruit for 2 minutes in an acid-brine solution made of 2 tablespoonfuls of vinegar and 2 tablespoonfuls of salt added to each gallon of water needed.

Filling.—Pack halved peaches closely into cans in overlapping layers, pit side down. Fill to within one-fourth inch of the top of can. Add boiling sirup to fill the can completely. A medium or heavy sirup made according to proportions given in table 9 may be used.

Exhausting.—Exhaust peaches to a center-can temperature of 160° F.

Sealing.—Seal cans immediately after removal from the exhaust box. Do not permit cans to cool before processing.

Processing.—Process peaches in boiling water (212° F.), as follows:

Size of can:	*Minutes*
No. 2	25
No. 2½	35
No. 3	35
No. 10	45

Cooling.—Immediately after processing is completed, cool the cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Pears

Container.—Use plain cans.

Quality of produce.—Pears develop a better flavor and finer texture if they are taken from the tree when mature and firm and held in crates for 5 to 10 days for ripening.

Preparation.—Discard bruised, rotten, wormy, or otherwise inferior fruit. Chill pears, cut in halves, and remove the core. A coring hook is desirable if many pears are to be cored. Trim away any blemishes as the fruit is pared. If it is necessary for pears to stand any length of time after paring and before filling into cans, discoloration may be prevented by dipping them into an acid-brine solution. To make this brine use 2 tablespoonfuls of vinegar and 2 tablespoonfuls of salt for each gallon of water needed. Dip the pears into the solution for 2 minutes. Precaution should be taken not to let pears stand in the solution longer than the period designated or the product will absorb the solution to such an extent that the flavor will be impaired.

[3] Clingstone peaches may be peeled by the same method but are more readily peeled when dipped into a lye solution.

Filling.—Pack halves of pears closely into cans in overlapping layers, filling to within one-fourth inch of the top of the can. Add boiling sirup to fill the cans completely. Use a light or medium sirup made according to proportions given in table 9.

Exhausting.—Exhaust pears to a center-can temperature of 160° F.

Sealing.—Seal cans immediately after removal from exhaust box. Do not permit cans to cool before processing.

Processing.—Process pears in boiling water (212° F.), as follows:

Size of can:	*Minutes*
No. 2	20
No. 2½	30
No. 3	30
No. 10	40

Cooling.—Immediately after processing is completed, cool the cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Pineapple

Container.—Use plain cans.

Quality of produce.—Pineapple should be fully matured when canned. Fruit that is too green will be lacking in flavor. Do not allow fruit to become overripe as fermentation rapidly sets in and makes the fruit unsuitable for canning.

Preparation.—Wash, pare, remove the eyes, and cut out the hard woody core. Cut the pineapple in about ½-inch slices or into chunks.

Filling.—Pack the pineapple into the cans to within one-fourth inch of the top and completely fill the cans with boiling sirup. Use a light or medium sirup made according to proportions given in table 9. The juice which drains from the fruit during preparation may be used in making the sirup.

Exhausting.—Exhaust to a center-can temperature of 170° to 180° F.

Sealing.—Seal cans immediately after removal from the exhaust box. Do not permit cans to cool before processing.

Processing.—Process pineapple in boiling water (212° F.), as follows:

Size of can:	*Minutes*
No. 2	20
No. 2½	25
No. 3	25

Cooling.—Immediately after processing is completed, cool the cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Plums

Container.—Use R-enamel cans.

Quality of produce.—Use fruit that is ripe but firm. Plums for canning should not be as ripe as for eating fresh since ripe fruit will become mushy in processing. Fruit that is too green will be sour and lacking in flavor. Soft fruit may be used for plum butter.

Preparation.—Sort plums, removing any defective fruit. Wash thoroughly to remove dust and spray residue. Plums may be pricked with a fork or other sharp instrument before packing to prevent their bursting in processing.

Filling.—Pack the plums as closely as can be done without crushing the fruit. Fill to within three-eighths inch of the top of cans. Add boiling sirup to fill the cans completely. Use a medium or heavy sirup made according to proportions given in table 9.

Exhausting.—Exhaust plums to a center-can temperature of 180° F.

Sealing.—Seal cans immediately after removal from the exhaust box. Do not permit cans to cool before processing.

Processing.—Process plums in boiling water (212° F.), as follows:

Size of can:	*Minutes*
No. 2	15
No. 2½	20
No. 3	20
No. 10	35

Cooling.—Immediately after processing is completed, cool the cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. When the cans are removed from the cooling water, they should be tilted, to drain off excess water and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Sauerkraut

Quality of produce.—Use varieties of cabbage that have been found satisfactory for making kraut and that are resistant to yellows or other disease. Late summer or fall cabbage usually is best for kraut. Cabbage heads should be solid, not less than 2 pounds in weight, and free from decay, discoloration, or damage from freezing.

Preparation.—Trim heads of cabbage to remove defective leaves or any bruised spots. Remove the outer green leaves. Wash heads thoroughly and drain well. The cabbage should be cored before shedding. Slaw cutters or hand-operated shredding machines may be used. In either instance the cutting knives should be kept very sharp and properly set. Shreds should be cut one thirty-second inch in thickness. Long shreds give the sauerkraut the most desirable appearance after curing. The length of the shreds depends upon the size of the cabbage and the way in which the heads are fed into the machine.

Tanks or barrels made of fir, cypress, or spruce are used for curing kraut. Other kinds of wood or concrete are not desirable for this use. Small amounts may be cured in stone jars. Care should be taken to

see that wooden tanks or barrels are watertight, as spoilage occurs when there is leakage of brine. They should be kept filled with clean water for a few days before using. The interior of wooden containers may be coated with waterproof material if desired.

The cut cabbage is placed in the container and salt is added at the rate of 2 to 2½ pounds per hundred pounds of cabbage. Less than 2 percent salt may cause kraut to soften and more than 2.5 percent may give a pink color to the fermented kraut. Spread the cabbage in thin layers and scatter salt over it in alternate layers, mixing enough to give an even distribution of salt through the cabbage. Uneven distribution of salt may cause a soft, spotted, or pink product. A good-grade canning salt that is fine-grained and free from lumps should be used. The cabbage should be packed firmly into the containers by using pressure to pack it down closely, in filling, but taking care not to break the cabbage shreds. A large hardwood masher is satisfactory for tamping. Sufficient brine is formed for curing and packing as the salt draws juice from the cabbage. After the container is filled, it is covered with a clean cloth and a clean wooden cover that is made in sections for convenience in handling. The cover is weighted down to bring the brine about 1 inch over the surface of the cabbage. Clean, hard stones are preferable for weights but clean bricks may be used, with only enough pressure to keep the brine at the desired level.

The temperature best for the fermentation of cabbage is about 65° F. This gives slower curing but a better flavor than does a higher temperature. A temperature that is too low will cause darkening of the kraut during fermentation. About 3 to 4 weeks are necessary for complete curing. Kraut that has been fermented rapidly will be lighter in color than that which is fermented slowly. The scum which forms during fermentation should be removed once or twice a week. Fermentation is completed when the cabbage develops a translucent appearance and the bubbles cease to rise at the sides of the container. When fermentation is completed the kraut should be removed from the container and canned. If kraut is left in the container after fermentation is completed it darkens and may acquire an off flavor. Any discolored kraut that may be at the top of the container should be discarded.

Preparation for canning.—Heat kraut in its juice or in 2-percent brine (approximately 3 ounces of salt to 1 gallon of water) to 160° F. before packing into cans. Turn kraut continually with long forks or paddles to assure even heating. Overheating causes kraut to darken.

Type of container.—Use R-enamel or plain cans.

Filling.—Fill kraut into cans to within one-fourth inch of top. Fill cans completely with a 2-percent brine that has been heated to boiling point.

Exhausting.—Exhaust, if necessary, to bring the center-can temperature up to 150° to 160° F.

Sealing.—Seal cans and place at once in open-process tanks. Do not permit cans to cool before processing.

Processing.—Process kraut in boiling water (212° F.), as follows:

Size of can:	*Minutes*
No. 2	15
No. 2½	20
No. 3	20
No. 10	30

Cooling.—Immediately after processing is completed, cool cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not stack cans or place them into cartons until cold and dry.

Tomatoes

Container.—Use plain cans.

Quality of produce.—Tomatoes for canning should be fully ripe but firm. Vine-ripened tomatoes give the best flavor and color. Smooth, regular shapes are more easily prepared and losses during preparation are lower than for those of irregular shapes. Tomatoes should be handled in containers that give protection from crushing. Broken, moldy, or diseased tomatoes contaminate the hampers and add danger of spoilage in canning.

Preparation.—Sort tomatoes and remove those that are green, overripe, moldy, wormy, sunburned, or otherwise defective. Wash carefully, changing water often enough to insure thorough removal of dirt and spray residue.

Scalding.—Place clean tomatoes in blanching basket and dip them into boiling water (212° F.) for ½ to 1 minute, according to the ripeness of the tomatoes. Water under boiling temperature will cook tomatoes rather than loosen the skins. Dip the tomatoes into cold water, to stop the cooking, and to crack the skins in order to make peeling easier.

Peeling.—The use of a tomato knife will expedite peeling. Remove the core first. The core hole should be as small as possible, yet all the core must be removed. This is important as portions of the core left in the tomato may retard the heat penetration and result in spoilage. To avoid loss of juice when peeling tomatoes take care not to cut the seed cells when removing the core or tear them in the subsequent peeling. Skins may be easily slipped off by twisting the tomato in the hand after loosening the skin near the core hole with the knife. Remove green or sunburned spots.

Filling.—Pack whole tomatoes [4] into cans, pressing them close to give a well-filled can. Fill cans completely. Do not add any water to tomatoes. Add

[4] The addition of calcium chloride ($CaCl_2$) to tomatoes at the time the cans are filled has been found to be a satisfactory method of retaining firmness in the canned product. Salt tablets are commercially available containing the concentration of calcium chloride recommended by the Food and Drug Administration (*12, p. 48*). One 6-grain calcium chloride tablet is placed in each No. 2 can before filling it with tomatoes. The disadvantage of these tablets is their tendency to dissolve when exposed in the humid air of the cannery. They must be kept in moistureproof containers and removed only as needed for immediate use.

salt, using ½ teaspoonful to each No. 2 can and 1 teaspoonful to each No. 3 can of tomatoes. Salt tablets may be used as follows:

Size of can:	Grains
No. 2	25 to 35
No. 2½	35 to 45
No. 3	45 to 60
No. 10	150 to 200

Exhausting.—Exhaust tomatoes to a center-can temperature of 140° F.

Sealing.—Seal cans immediately after removal from exhaust box. Do not permit cans to cool before processing.

Processing.—Process tomatoes in boiling water (212° F.), as follows:

Size of can:	Water-cooled Minutes	Air-cooled Minutes
No. 2	45	35
No. 2½	55	45
No. 3	55	45
No. 10	90	70

Water cooling.—Immediately after processing is completed place the basket of cans in cooling tank filled with cold, clean water. Water should be admitted to the tank continually to cool the cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Air cooling.—Remove the cans from the retort basket and place them in a cool room where there is good ventilation. Cans may be placed on the floor or on a table. Leave sufficient space between cans to permit good circulation of air. Do not stack hot cans. Do not put cans into cartons until cold and dry.

Tomato juice

Container.—Use plain cans.

Quality of produce.—Tomatoes for juice should be fully ripe and sound. Vine-ripened tomatoes give the best flavor and color and may be left on the vines for a day or two longer than those used for canning. However, tomatoes that are overripe give a thin juice that is lacking in flavor. Imperfectly shaped tomatoes that do not give an attractive product when canned whole may be used for making juice. Broken, diseased, or inferior tomatoes should not be used since the flavor of mold or other spoilage is carried entirely through the tomatoes. The quality of the juice depends on the quality of the tomatoes used.

Preparation.—Sort tomatoes to remove any that are green, sunburned, diseased, or otherwise defective. Wash carefully, changing the water often enough to thoroughly remove any dirt and spray residue.

Preheating.—Preheating of tomatoes before extraction of juice gives a better color, flavor, and consistency to the canned product. There is less separation in the canned juice when tomatoes are preheated. Best results are obtained if the tomatoes are heated slowly to 160° to 170° F. Press the tomatoes through a sieve to separate the skins and seeds from the juice, being careful to avoid inclusion of air as this will cause loss of color and vitamins. A cone-shaped sieve is preferable because it allows the least air to be incorporated in the pulp. Where large quantities are being handled a pulper will expedite the pulping process. The pulper screen should be of 0.023-inch size. The injection of steam into the pulper during the operation will help to keep the air out of the pulp. Heat juice to 190° to 200° F. Do not stir juice as this will incorporate air in the product.

Filling.—Fill tomato juice into cans as soon as it has reached the desired temperature. Fill cans full. Add ½ teaspoonful of salt to each No. 2 can and 1 teaspoonful to each No. 3 can of juice. Salt tablets may be used, as follows:

Size of can:	Grains
No. 2	50 to 60
No. 2½	60 to 75
No. 3	75 to 90

Exhausting.—It is not necessary to exhaust tomato juice if cans are sealed at a temperature of 190° F.

Processing.—Process tomato juice in boiling water (212° F.), as follows:

Size of can:	Water-cooled Minutes	Air-cooled Minutes
No. 2	30	20
No. 2½	35	25
No. 3	35	25

Water cooling.—Immediately after processing is completed place the basket of cans in cooling tank filled with cold, clean water. Water should be admitted to the tank continually to cool the cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Air cooling.—Remove the cans from the retort basket and place them in a cool room where there is good ventilation. Cans may be placed on the floor or on a table. Leave sufficient space between cans to permit good circulation of air. Do not stack hot cans. Do not put cans into cartons until cold and dry.

Canning nonacid vegetables

Nonacid vegetables require processing in a steam-pressure retort or canner at temperatures of 240° and 252° F. If such equipment is not available, these vegetables should not be canned but be preserved by some other method, such as drying, brining, or freezing. Salt is added to nonacid vegetables to take away the raw vegetable flavor, thus making them more palatable. Salt may be made up into a brine solution or used in tablet form.

Brine.—Care should be taken in making up the brine, as the finest product can be ruined if clean salt water is not used. Hard water or that containing high amounts of iron should not be used without preheating, settling, and filtering. A 2-percent brine

TABLE 10.—*Time and temperature for processing fruits, tomatoes, and other acid foods*

Produce	Type of can	Recommended center-can closing temperature	Time to process in boiling water (212° F.) at sea level [1]			
			Size of can			
			No. 2	No. 2½	No. 3	No. 10
		° F.	Minutes	Minutes	Minutes	Minutes
Apple butter	Plain	190	10	10	10	10
Apples in sirup	do	190	10	10	10	10
Applesauce	do	190	10	15	15	20
Apricots	do	160	25	35	35	40
Berries	R-enamel	170	15	20	20	25
Cherries, sour	do	170	15	20	20	30
Cherries, sweet	Plain	170	15	20	20	30
Peaches	do	160	25	35	35	45
Pears	do	160	20	30	30	40
Pineapple	do	180	20	25	25	
Plums	R-enamel	180	15	20	20	35
Sauerkraut	R-enamel or plain	160	15	20	20	30
Tomatoes (water-cooled)	Plain	140	45	55	55	90
Tomatoes (air-cooled)	do	140	35	45	45	70
Tomato juice (water-cooled)	do	190	30	35	35	
Tomato juice (air-cooled)	do	190	20	25	25	
	Time to process in water at 180° F.					
Fruit juices	R-enamel	170	20	20	20	
Grapefruit	Plain	160	10			

[1] When using the boiling water-bath process, add 1 minute for each 1,000 feet above sea level when the processing time is 20 minutes or less, and 2 minutes for each 1,000 feet when the processing time is longer than 20 minutes.

is satisfactory for general use. It is made by adding 2 pounds of salt to 12 gallons of water. A standard measuring cup will contain approximately 10 ounces of running salt. Heat to boiling before using, making sure that all salt is dissolved.

Salt tablets.—Community canneries are finding salt tablets more convenient than brine for some products. Products to which salt tablets may be satisfactorily added are given in table 11.

TABLE 11.—*Quantity of salt in tablets of various sizes used in canning nonacid vegetables* [1]

Produce	Size of salt tablet according to—			
	Size of can			
	No. 2	No. 2½	No. 3	No. 10
	Grains	Grains	Grains	Grains
Asparagus cuts	60–90	100–150	150–200	450
Asparagus spears	60–90	100–150		
Beans, green and wax	50–75	75–90	90–100	250–300
Beans, green lima	50–75	75–90	90–100	250–300
Beets	50–75	75–90	90–100	250–300
Carrots	50–75	75–90	90–100	250–300
Corn, whole-grain	50–75			
Greens	60–90	100–150	150–200	450
Mixed vegetables	50–75	75–90	90–100	
Okra	50–75			
Peas	50–75	75–90	90–100	250–300
Summer squash	50–75			

[1] The salt tablet is placed on top of the product after it is filled into the can. Add boiling water to fill can completely.

Asparagus

Container.—Use plain cans.

Quality of produce.—Only young, tender stalks should be used, and they should be canned as soon as possible after harvesting, or they will become tough and bitter. White asparagus is cut below the ground before the stalk has been exposed to the light. Green asparagus is cut after the stalks have grown about 9 inches above the ground. In either kind, stalks that are deformed or show evidence of rust should not be used. Stalks with tight heads make the most attractive pack.

Preparation.—Break the stalks to separate the tender portion from the tough portion. The fibrous end is too tough for food and should be discarded. Tender stalks to be packed whole should be cut into uniform length about ¼ inch less than the height of the can. Any tender portions that are trimmed off may be cut into ½-inch lengths and canned as asparagus cuts. Wash thoroughly. Particular care must be used to remove dirt and sand from tips and leaflets. Washing is facilitated by using water at a temperature of 140° to 150° F.

Blanching.—Blanch at from 190° to 200° F. Place asparagus in a blanching basket and submerge in the blanching water until the asparagus has wilted sufficiently to become pliable. This takes from 3 to 5 minutes depending on the size of the stalks. Place the blanched asparagus quickly in cold water to stop the blanching process and to cool it sufficiently so that it may be packed immediately. Do not allow

the asparagus to remain in the cooling water more than a few seconds.

Filling.—If the asparagus is to be packed whole, sufficient stalks to fill the can should be gathered in a bundle, with the cut ends down. The bundle should then be worked into the mouth of the can with the spear ends down and the can tapped on the table to settle the stalks to the bottom. A firm pack is desirable and will help to keep the asparagus from breaking up in subsequent handling. Too tight a pack should be avoided. In packing asparagus cuts into cans, use the can as a scoop, and dip it into the asparagus sections with one hand while pressing them down with the other. Tap the can sharply on the top of the table to settle the asparagus. Fill to within one-fourth inch of the top of can. Add boiling brine to fill the can completely or use salt tablet and boiling water. (See instructions on brine and salt tablets, p. 68.)

Exhausting.—Exhaust to a center-can temperature of 140° F.

Sealing.—Seal cans immediately after removing from the exhaust box and place at once in the retort. Do not permit cans to cool before processing.

Processing.—Cans containing whole spears must be placed in the retort so that the tips are down and the spears are in a vertical position. (See explanation of principles of heat penetration, p. 57.) If cans containing spears are placed on their sides, serious underprocessing may result.

Process asparagus at 240° F., as follows:

SPEARS

Size of can:	*Minutes*
No. 2	25
No. 2½	25

CUTS

Size of can:	*Minutes*
No. 2	25
No. 2½	25
No. 3	26
No. 10	35

Cooling.—Immediately after processing is completed, cool the cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. Nonacid products canned in No. 3 cans or smaller can be cooled successfully in cold running water. No. 10 cans must be cooled under pressure. (See instructions for pressure cooling cans, p. 18.) When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Beans, green and wax

Container.—Use plain cans.

Quality of produce.—Snap beans for canning should be fresh and tender and as free as possible from strings or fiber. When beans have become so mature that the seed leaves the pod when cooked they should be dried and not canned. The time and temperature given for processing snap beans will not be adequate for overmature beans. Slat hampers or baskets that afford good ventilation are best for harvesting or transporting snap beans, as they may heat and become slimy if packed in tight containers. Burlap bags should not be used for snap beans because the rough surface of the bean pod catches lint that is almost impossible to remove in washing. Snap beans should not be harvested while the vines are wet. Beans should be canned as soon as possible after harvesting for they become wilted, dark, and tough if held too long in storage.

Preparation.—Snap the ends and break or cut the beans into pieces before washing. A quick method is to snip the stem end of the bean and at the same time inspect it for insect injury or other defects. There is no reason for removing the blossom end of stringless beans. The beans may be broken quickly and almost simultaneously with the snipping by pressing the bean with the thumb between the index and middle fingers of the hand holding the pod. Where it is desirable to snip both ends this may be followed by breaking or the beans may be cut on a cutting board by using a sharp knife and cutting several pods at one time. Beans are usually cut or broken into 1½-inch lengths. After cutting or breaking is completed, wash beans carefully to remove grit or dust.

Blanching.—Blanch beans at 190° F. Place the beans in a blanching basket and submerge in the blanching water. Continue the blanching only long enough for the beans to become pliable. The time required for blanching will vary from 1½ to 3 minutes for small-sized beans. Large sizes will require more time. Overblanching causes beans to become soft or slimy. Plunge blanched beans quickly into cold water to stop the blanching process and to cool thoroughly before packing. Move the beans around in the blanching basket to expedite cooling. This prompt and thorough cooling assists in preventing sliminess and will help to prevent beans from matting in the can when packed. Do not let beans remain in the cooling water longer than is necessary.

Filling.—Using the can as a scoop, fill it with beans by dipping it into the blanched beans with one hand, and pressing them down into the can with the other. Tap the cans sharply on the top of the table to settle the beans. Fill beans into cans to within one-fourth inch of top. Add boiling brine to fill the cans completely or use salt tablet and boiling water. (See instructions on brine and salt tablets, p. 68.)

Exhausting.—Exhaust to a center-can temperature of 140° F.

Sealing.—Seal cans immediately after removing from the exhaust box and place them at once in retort. Do not permit cans to cool before processing.

Processing.—Process snap beans at 240° F., as follows:

Size of can:	*Minutes*
No. 2	20
No. 2½	25
No. 3	25
No. 10	35

Cooling.—Immediately after processing is completed, cool cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. Nonacid products canned in No.

3 cans or smaller can be cooled successfully in cold running water. No. 10 cans must be cooled under pressure. (See instructions for pressure cooling of cans, p. 18.) When the cans are removed from the cooling water they should be tilted, to drain off excess water, and stacked in a well-ventilated place until cool. Do not put the cans into cartons until cold and dry.

Beans, green lima

Container.—Use C-enamel or plain cans.

Quality of produce.—Only young and tender lima beans should be canned. Older beans should not be canned because of the high starch content, but they may be dried successfully. Lima beans have reached the proper maturity for canning when the pods are still green but the beans are easily shelled. They should be handled in small quantities so that they may be canned quickly.

Preparation.—Shell lima beans as soon as possible after harvesting. Discard defective beans. Wash in a wire basket by dipping the basket up and down in the washing water until the beans are clean.

Blanching.—Blanch at 190° to 200° F. Place lima beans in the blanching basket and dip into blanching water. Smaller beans are blanched at 200° for 2½ to 3 minutes. More mature beans are blanched 4 to 5 minutes at 190° to prevent bursting of the skins.

Filling.—Drain beans and fill at once to within one-half inch of the top of cans. Fill cans completely with boiling brine or use salt tablets and boiling water. (See instructions on brine and salt tablets, p. 68.)

Exhausting.—Exhaust to a center-can temperature of 140° F.

Sealing.—Seal cans immediately after removal from the exhaust box and place at once in the retort. Do not permit cans to cool before processing.

Processing.—Process lima beans at 240° F., as follows:

Size of can:	Minutes
No. 2	35
No. 2½	40
No. 3	40
No. 10	55

Cooling.—Immediately after processing is completed, cool the cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. Nonacid products canned in No. 3 cans or smaller can be cooled successfully in cold running water. No. 10 cans must be cooled under pressure. (See instructions for pressure cooling of cans, p. 18.) When cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Beets

Container.—Use R-enamel cans.

Quality of produce.—Use young tender beets for canning. Beets should be canned soon after harvesting, as storage for any length of time may result in a bitter flavor. Those having a uniform dark red color are more desirable for canning than those of lighter color. Beets that have been slowed in development by dry weather should not be canned, as they will be fibrous and woody. Tops of young beets may be canned as greens.

Preparation.—Leave the root and 1 inch of the leaf stalks on the beets to prevent the bleeding of red color during steaming. Wash the beets thoroughly. It may be desirable to soak beets to loosen dirt before washing. Use a vegetable brush in washing but take care not to break the skin or root. The last washing should show no evidence of dirt. The use of a spray will expedite washing when large quantities are being handled. Grade beets for uniformity in size to assure even steaming for peeling. They are usually sorted into three sizes, as follows: Small, less than 1 inch in diameter; medium, 1 to 1½ inches in diameter; and large, more than 1½ inches in diameter.

Steam beets at about 230° F. (6 pounds pressure) for 10 to 15 minutes, according to the size. Wire-lined retort crates or blanching baskets may be used for placing beets in the retort. Cool beets in cold water immediately on removal from the retort. Do not cool more than is necessary for handling in peeling. Prompt handling is necessary as delay in peeling will make the skin more difficult to remove. Slip skin off the beets by hand. Trim off any blemishes or woody portions. If the whole beet is fibrous it should be discarded, as such a one would retard heat penetration and therefore cause spoilage. Cube, quarter, or slice large beets before filling into cans. Slices are usually ⅜-inch thick. Small- or medium-sized beets may be canned whole.

Filling.—Fill beets promptly into cans to within one-fourth inch of top. There should be no delay in filling since beets darken rapidly after peeling or slicing. Fill can completely with boiling water or brine. (See instructions on brine and salt tablets, p. 68.)

Exhausting.—Exhaust beets to a center can temperature of 160° F.

Sealing.—Seal cans immediately after removing from exhaust box and place at once in retort. Do not permit cans to cool before processing.

Processing.—Process beets at 240° F., as follows:

WHOLE, CUBED, OR QUARTERED		SLICED	
Size of can:	Minutes	Size of can:	Minutes
No. 2	30	No. 2	30
No. 2½	30	No. 2½	30
No. 3	30	No. 3	30
No. 10	40	No. 10	45

Cooling.—Immediately after processing is completed, cool the cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. Nonacid products canned in No. 3 cans or smaller can be cooled successfully in cold running water. No. 10 cans must be cooled under pressure. (See instructions for pressure cooling of cans, p. 18.) When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Carrots

Container.—Use plain cans.

Quality of produce.—Carrots for canning should be crisp and tender. Only fully matured ones should be used since those that are underdeveloped will lack flavor. Any that have become fibrous or woody because development was slowed by dry weather or poor soil should not be canned, as such carrots would retard heat penetration and in this way cause spoilage. The best flavor and quality are obtained from carrots that have developed rapidly.

Preparation.—Leave 1½ to 2 inches of the leafstalk at the top for holding the carrot while peeling. Soak carrots if necessary to loosen the soil before washing. Scrub with a stiff brush until carrots are clean. The use of a spray will expedite washing when large quantities are being handled. Use the top of the carrot for holding while removing a thin peel from the carrot. A knee-action peeling knife is excellent for peeling carrots as peeling is done on both the up and the down strokes. Remove the top when peeling is completed. Small carrots may be canned whole. Larger carrots may be sliced, or cut into wedges or cubes, for canning. Wash carrots before filling into cans.

Filling.—Pack carrots into cans as closely as possible to within one-fourth inch of top. Fill cans completely with boiling water or brine. (See instructions on brine and salt tablets, p. 68.)

Exhausting.—Exhaust carrots to a center-can temperature of 160° F.

Sealing.—Seal cans immediately after removing from exhaust box and place at once in retort. Do not permit cans to cool before processing.

Processing.—If whole carrots are packed asparagus style, the cans should be processed on end. Process carrots at 240° F., as follows:

WHOLE, WEDGES, OR CUBES		SLICED	
Size of can:	*Minutes*	Size of can:	*Minutes*
No. 2	30	No. 2	30
No. 2½	30	No. 2½	30
No. 3	30	No. 3	30
No. 10	40	No. 10	45

Cooling.—Immediately after processing is completed, cool the cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. Nonacid products canned in No. 3 cans or smaller can be cooled successfully in cold running water. No. 10 cans must be cooled under pressure. (See instructions for pressure cooling of cans, p. 18.). When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Corn, cream-style

Container.—Use C-enamel cans.

Quality of produce.—Maturity for canning is indicated generally by the appearance of the silks which are dried at the tip but green next to the husks. The best test for maturity is to open a few ears and press the kernels with the thumbnail. Milk from the kernels should be creamy rather than watery. When the grain is tough and the liquid is starchy, the corn is too old for canning and should be dried, salted, or brined. Corn must be canned promptly as there is a rapid change of sugar to starch with an accompanying toughening of fiber and loss of flavor after the corn is harvested; therefore, there should be the least possible delay between harvesting and canning and only such a quantity as can be canned quickly should be harvested. Care must be used in harvesting and transporting corn to the cannery to avoid heating and the subsequent growth of bacteria that occurs readily when corn is packed too close. Heating will lower the quality of canned corn and may result in spoilage.

Preparation.—Husk and silk the corn, removing as much silk as possible with the husk. A table in the receiving area of the cannery is used for this part of the preparation. Use a sharp knife to cut away all wormy portions and blemishes. Discard ears that have smut growth or other disease. Remove silk with a medium stiff brush. Wash the corn in cold water and remove the remaining silks and any foreign material with a brush. Grade the corn as it is washed and reserve the more mature ears for canning cream-style and the others for whole-grain canning.

Cutting.—Cut the corn at the preparation table; use sanitary practices that will avoid contamination which occurs very readily at this time. A corn-cutting block, such as is shown in figure 66, should be placed in the bottom of the preparation pan to hold the ear of corn while cutting it. In using such a block the knife strikes against the wood rather than the pan. Place the butt end of the ear of corn on the point of the nail. Hold the corn ear in position and revolve it with one hand while cutting the kernels with the other.

To insure a product of good quality it is important that corn be cut in a proper manner with a sharp knife. A thin slicing knife is best for cutting corn. In cutting, start the knife at the top of the ear and slice downward with a diagonal motion using as little pressure on the knife as possible and one motion from the top to the bottom of the ear. Cut the slice one-sixteenth to one-eighth inch thick. Turn the knife over and use the back to scrape the exposed pulp, taking care not to scrape so deep as to include any part of the cob, as this will give an undesirable flavor and color to the finished corn. Do not cut too many rows at one time or it will be impossible to get a layer as thin as desired. When cutting is finished the

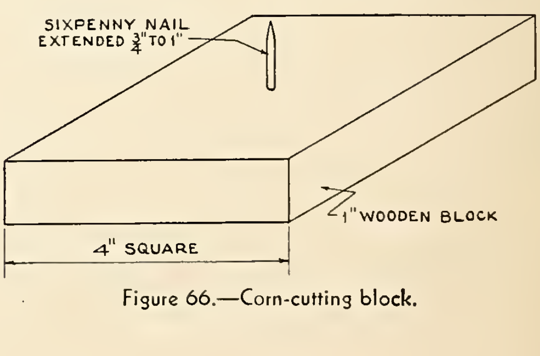

Figure 66.—Corn-cutting block.

cob should be round with all grain pockets remaining on the cob. It is desirable, for one person to cut and another to do the scraping, when possible, as this will quicken the preparation and make the cutting easier.

Blending.—Blending is accomplished by constant stirring or agitation while the corn is heating and, at the same time, by adding brine, water, or a salt, sugar, and water solution to secure the proper consistency. Where sweet corn of proper maturity is used a 2-percent brine or water may be used in blending. With older corn, a salt, sugar, and water solution is used. The solution should be prepared before the corn is cut. It is made by adding approximately 1 to 1½ ounces of sugar to 1 gallon of 2-percent brine. The amount of sugar used will vary with the sweetness of the corn. The use of too much sugar should be avoided as it will mask the natural flavor of the corn. Heat the sugar, salt, and water to the boiling point and boil 5 minutes, removing any scum that forms on top. Blending is best accomplished by the use of a steam-jacketed kettle or an open tank that is heated by closed steam coils. If an open steam pipe is used for heating, a certain amount of water is added by condensation of the steam for which allowance must be made. Where corn is heated over direct heat, caramelization may occur. Apply heat slowly to avoid caramelization or scorching. Heat corn to 190° to 200° F.

Add brine, water, or solution as necessary to obtain a consistency that is neither starchy nor pasty. Keep stirring corn while adding liquid. Cook the corn until it reaches the consistency of thin cream and when dropped from a spoon or paddle will seek its own level. The corn will thicken in processing and cooling and should not be too thick when processing is completed.

Filling.—Fill the corn, at 185° F. or higher, into No. 2 cans to within one-fourth inch of the top.

Exhausting.—It is not necessary to exhaust cream-style corn if the corn is sealed immediately after filling. An initial temperature of 180° F. is necessary at the time processing is started. The processing time given will not be adequate and spoilage may result unless this initial temperature is maintained. (See statement on initial temperature, p. 56).

Sealing.—Seal cans as they are filled and place them immediately in the retort. Do not permit cans to cool before processing.

Processing.—Process No. 2 cans of cream-style corn at 240° F. for 90 minutes. Raise the temperature on corn slowly at the beginning of the process, as a full force of steam at the beginning of the process throws an intense heat on the outside of the cans and may cause more or less sticking and scorching before currents are set up in the mass of corn. The sudden application of intense heat produces a distinctly darker product than when less vigorous methods are used.

Cooling.—Immediately after processing is completed, cool the cans as rapidly as possible in cold running water to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Corn, whole-grain

Container.—Use C-enamel cans.

Quality of produce.—Slightly less mature corn is used for whole-grain than for the cream-style product. The corn may be selected by sorting during the first stage of preparation for canning. The general standards for quality and handling after harvesting are the same for whole-grain corn as those given for cream-style.

Preparation.—Husk and silk the corn, removing as much silk as possible with the husk. A table in the receiving area of the cannery is used for this part of the preparation. With a sharp knife, cut away all wormy portions and blemishes. Discard ears that have smut growth or other disease. Remove silk with a medium stiff brush. Wash the corn in cold water and remove the remaining silks and any foreign material with a brush. Grade the corn as it is washed, reserving the less mature for whole-grain canning, and the more mature for cream-style. Precook ears of corn in boiling water 3 to 5 minutes or until the milk in the kernels sets. Test with a fork or other sharp implement to see when the milk has set in the kernels.

Cutting.—Use the cutting board with a nail in the center and set the butt end of the ear of corn on the nail. (See fig. 66.) Cut with one hand and revolve the ear of corn with the other. A thin sharp knife, preferably a 6-inch slicing knife, is best for this purpose. Do not cut too many rows at one time as this may result in cutting too close to the cob. Cut two-thirds of the total depth of the kernel and use one stroke of the knife to cut from the top to the bottom of the ear. Deep cutting will remove chaff of cob which gives an off-flavor and darkened color. Do not scrape the cob because the processing time for whole-grain corn is based on the requirements for clear brine and is shorter than the time required for cream-style corn. After cutting, wash kernels of corn on a screen. A screen may be made of fine-mesh hardware cloth fastened over a small wooden box. This will permit the chaff and small particles to go through the mesh but retain the kernels and make possible a clear liquor.

Filling.—Fill corn into No. 2 cans to within one-half inch of the top. Fill cans completely with boiling water or brine. (See instructions on brine and salt tablets, p. 68.)

Exhausting.—Exhaust to a center-can temperature of 185° F.

Sealing.—Seal cans immediately after removing from the exhaust box, and place at once in retort. Do not permit cans to cool before processing.

Processing.—Process No. 2 cans of whole-grain corn at 240° F. for 50 minutes.

Cooling.—Immediately after processing is completed, cool the cans as rapidly as possible in cold running

water to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Greens

Container.—Use plain cans.

Quality of produce.—Any cultivated or wild greens that are used fresh may be canned. Only crisp, young, tender greens should be canned since tough stems lower the flavor and texture and cause slow heat penetration. In harvesting greens use slatted crates to assure good ventilation and to prevent their heating.

Preparation.—Greens should be sorted and trimmed before washing since they mat and become more difficult to sort when wet. Remove old, discolored, or inferior leaves and fibrous stems. In sorting, shake off loose sand. Greens must be washed thoroughly and carefully to remove all soil. Use a large volume of water and wash a small enough quantity at one time to avoid matting. A wire rack in the bottom of the washing tank permits sand or dirt to fall to the bottom of the tank and makes washing easier. Several waters are necessary for thorough cleansing of greens. Washing should be continued until the last water is clear and there is no trace of sand in the washing tank.

Blanching.—Fill the blanch baskets one-third to one-half full of greens. Over-filling causes matting which retards circulation of water through the greens and gives an uneven blanch. Move the greens back and forth in the blanching water to aid in the removal of gases. Blanch greens at a temperature of 190° to 200° F. for 2 to 4 minutes. Blanching is completed when greens are pliable rather than crisp and are shrunk enough to insure a desirable fill in the cans. Do not continue blanching longer than is necessary as overblanching will cause greens to be slimy or mushy.

Filling.—Drain greens for a few minutes to remove excess water. Draining too long will cause matting of greens and make them difficult to pack. Pack by weight to avoid slack fill or overfill. The drained weight specifications are as important as the recommendations for time and temperature. Overfilling will retard heat penetration and may result in spoilage. (See statement on checking weight of can contents, p. 55.) The recommended maximum drained weights are given below. These weights must not be exceeded.

Size of can:	*Ounces*
No. 2	14½
No. 2½	21
No. 3	23
No. 10	66

The minimum drained weights necessary to avoid slack fill are as follows:

Size of can:	*Ounces*
No. 2	13
No. 2½	19
No. 3	21½
No. 10	60

After filling use a pointed stick to push through the center and to the bottom of the filled can to loosen the greens and to assure the distribution of the brine throughout the product, thus aiding heat penetration. Add boiling brine to fill the can completely, or use boiling water and a salt tablet. (See instructions on brine and salt tablets, p. 68.)

Exhausting.—Exhaust to a center-can temperature of 150° to 160° F.

Sealing.—Seal cans immediately after removing from the exhaust box and place at once in the retort. Do not permit cans to cool before processing.

Processing.—Process greens at 252° F., as follows:

Size of can:	*Minutes*
No. 2	45
No. 2½	50
No. 3	50
No. 10 [1]	60

[1] Since blanched greens tend to become stratified horizontally in No. 10 cans, heat penetration will be more rapid when these cans are processed on their sides rather than in a vertical position. It is strongly recommended therefore that No. 10 cans be processed in a horizontal position.

Cooling.—Immediately after processing is completed cool cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and prevent rusting. Because of the high temperature at which greens are processed, difficulty may be encountered in the buckling of No. 3 or smaller cans and it may be necessary to cool them under pressure. No. 10 cans must be cooled under pressure. (See instructions for pressure cooling of cans, p. 18.) When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not place cans into cartons until cold and dry.

Mixed vegetables for soup or salad

Container.—Use plain cans.

Quality of produce.—The same quality is necessary for mixed vegetables canned for use in soups or salads as for vegetables canned separately. Defective or overmature vegetables should not be canned. The following vegetables may be canned in any combination desired (starchy vegetables, such as potatoes or corn, should not be added): Cut snap beans; cut asparagus; cut celery; baby lima beans; peas; carrots.

Preparation.—Prepare each vegetable as for canning alone, using care not to hold cut vegetables longer than is necessary, as this will cause discoloration. Mix vegetables in desired proportions.

Filling.—Fill vegetables into cans to within one-fourth inch of top. Completely fill cans with boiling brine or use salt tablet and boiling water. (See instructions on brine and salt tablets, p. 68.)

Exhausting.—Exhaust to a center-can temperature of 150° to 160° F.

Sealing.—Seal cans immediately after removal from the exhaust box and place them at once in the retort. Do not permit cans to cool before processing.

Processing.—Process mixed vegetables at 240° F., as follows:

Size of can:	Minutes
No. 2	35
No. 2½	45
No. 3	45

Cooling.—Immediately after processing is completed, cool the cans as rapidly as possible in cold running water to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then should be stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Okra

Container.—Use plain cans.

Quality of produce.—Okra pods should be canned while they are still soft. The pods should be harvested every 2 or 3 days so that they will be tender. Old pods should not be canned. The pods may be cut or broken from the stalks. Slat hampers or baskets that afford good ventilation are best for harvesting and transporting okra as the pods may heat and become slimy if packed in tight containers.

Preparation.—Wash okra pods thoroughly by placing them in a wire basket and dipping up and down in water. Do not let okra stand in the water. Blanch okra from 3 to 4 minutes in water at 190° F. After blanching, the okra should be dipped into cold water and drained immediately. Sort to remove off-colored or damaged pods. Use a sharp knife to remove the stem and tip ends. Stainless-steel knives should be used since okra is very readily discolored. Ordinary steel knives have a tendency to discolor the pods at the freshly cut surfaces. Cut pods into length of about three-fourths inch.

Filling.—Pack okra into No. 2 cans to within one-fourth inch of the top as quickly as possible after trimming. Add boiling brine to fill the can completely or use salt tablet and boiling water. (See instructions on brine and salt tablets, p. 68.)

Exhausting.—Exhaust to a center-can temperature of 150° to 170° F.

Sealing.—Seal cans immediately after removing from the exhaust box and place at once in the retort. Do not permit the cans to cool before processing.

Processing.—Process No. 2 cans of okra at 240° F., for 17 minutes.

Cooling.—Immediately after processing is completed, cool cans as rapidly as possible in cold running water to approximately 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Peas, green

Container.—Use plain cans.

Quality of produce.—Only young, tender peas should be canned. Peas that are overmature should be dried. Peas should be canned promptly after harvesting.

Preparation.—Shell peas by hand or with a pea huller. Shelling is accomplished more readily when peas are fresh and crisp. Hand shelling may be quickened by placing peas in a blanching basket, dipping them for a few seconds in boiling water, and plunging them quickly into cold water. Discard broken, ripe, or hard peas as they are shelled. After peas have started to lose their bright color they should not be canned because they are too mature. Do not permit peas to stand after shelling but complete the canning process as soon as possible to obtain the best quality. Wash peas in a large colander or blanching basket lined with No. 6 mesh hardware cloth. Dip them up and down in cold water removing imperfect peas or particles of pod that float to the top of the water.

Blanching.—Blanch peas for 3 to 5 minutes at 190° to 200° F. Blanching is an important step in the canning of peas. One of the principal objectives in blanching is to remove mucous substance and starch from peas in order to give a clear liquor. The blanch is followed by a quick plunge into clean, cold water.

Filling.—Fill peas into cans to within one-fourth inch of the top immediately after cooling. Fill cans completely with boiling water or brine. (See instructions on brine and salt tablets, p. 68.)

Exhausting.—Exhaust peas to a center-can temperature of 140° F.

Sealing.—Seal cans immediately after removing from the exhaust box and place at once in the retort. Do not permit cans to cool before processing.

Processing.—Process green peas at 240° F., as follows:

Size of can:	Minutes
No. 2	35
No. 2½	40
No. 3	40
No. 10	55

Cooling.—Immediately after processing is completed, cool the cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. Nonacid products canned in No. 3 cans or smaller can be cooled successfully in cold running water. No. 10 cans must be cooled under pressure. (See instructions for pressure cooling of cans, p. 18.) When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Pumpkin and squash

Container.—Use R-enamel cans.

Quality of produce.—Pumpkin and squash for canning should have firm, dry meat. They should be fully ripened, and of good texture and color. Frosted pumpkin or squash cannot be canned successfully. In harvesting pumpkin and squash the stems should not be detached, as breaking off the stem leaves an exposed surface which serves as a point where rotting or souring may occur.

Preparation.—Wash carefully to remove all soil. Cut open and remove seeds and fiber. Discard any

pumpkin or squash that shows evidence of internal rot as this will spoil the flavor of the finished product and may result in spoilage. Cut into uniform sections for steaming. The skin may be left on or when small quantities are being canned the sections may be pared. Place chunks two or three layers deep in heavily tinned wire baskets and set them inside of crates in the retort for steaming. Steam for 15 to 25 minutes at 220° F. or until soft. Steaming of small lots may be accomplished in the same manner in a pressure canner. In order to get a dry pack, leave the vent on the cover of the retort or pressure canner open, and steam the product for a longer period of time. This will cause some evaporation from the product. When the steaming is completed open wide the retort or pressure canner as quickly as possible, leaving the crate in place for a short time so that evaporation will produce a dry product. Put through a sieve to produce a pulp and drain off any excess liquid. Handle the pulp as hot as possible. To evaporate the product further, place pulp in a steam-jacketed kettle and heat to 200° to 212° F.

Filling.—Fill cans as quickly as possible to within one-eighth inch of the top.

Exhausting.—If the pulp is filled promptly into cans, an exhaust will not be necessary. However, it is important that a center-can temperature 5° higher than the initial temperature be maintained. The initial temperature is an essential part in the processing of pumpkin and squash. It is desirable that the initial temperature be 180° F. and essential that it shall not drop below 160°. (See statement on initial temperature, p. 56.)

Sealing.—Seal the cans and place at once in the retort. Do not permit cans to cool before processing.

Processing.—Process pumpkin and squash at 240° F., as follows (if the initial temperature falls below 180° F., process for the time given for the initial temperature of 160°):

Size of can:	180° F. initial temperature *Minutes*	160° F. initial temperature *Minutes*
No. 2	70	80
No. 2½	95	105
No. 3	100	110
No. 10	190	210

Cooling.—Immediately after processing is completed cool the cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. Nonacid products canned in No. 3 cans or smaller ones can be cooled successfully in cold running water. No. 10 cans must be cooled under pressure. (See instructions for pressure cooling of cans, p. 18.) When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Summer squash

Container.—Use plain cans.

Quality of produce.—Summer squash, such as crookneck, scallop, straightneck, and zucchini, may be canned. Only young, tender squash should be used. Do not use any squash that has begun to mature.[5]

Preparation.—Wash thoroughly, cut off stems, and cut into ½- to ¾-inch slices.

Filling.—Pack loosely into No. 2 cans to fill them. There should be as little delay as possible between slicing and filling. Fill cans completely with boiling brine or use salt tablet and boiling water. (See instructions on brine and salt tablets, p. 68.)

Exhausting.—Exhaust to a center-can temperature of 150° to 160° F.

Sealing.—Seal cans immediately after removing from exhaust box and place at once in the retort. Do not permit cans to cool before processing.

Processing.—Process summer squash at 240° F., as follows:

Size of can:	*Minutes*
No. 2	40

Cooling.—Immediately after processing is completed, cool the cans as rapidly as possible in cold running water to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Sweetpotatoes in sirup

Container.—Use plain cans.

Quality of produce.—Freshly dug sweetpotatoes are best for canning. However, stored sweetpotatoes that have been cured may be canned. In the latter case the sweetpotatoes may be somewhat softer, owing to the higher sugar content of the cured product. Care should be taken not to bruise the sweetpotatoes as soft rot develops quickly. Sweetpotatoes harvested from vines that have been frosted should not be canned. It is preferable to use small sweetpotatoes for canning in sirup as they may be packed whole. If larger sweetpotatoes are used, cut them in uniform slices lengthwise of the sweetpotato.

Preparation.—Wash the sweetpotatoes thoroughly in cold water to remove all dirt. To peel sweetpotatoes that are to be packed in sirup, it is best to use the lye method of peeling as they may be packed without precooking. This will prevent the possibility of overfilling the can and permit good circulation of the sirup throughout the pack. The shorter processing time given for this type of pack is possible only when a canning medium is used. To lye-peel sweetpotatoes, place them in boiling lye solution which has been made by adding 9¼ pounds of granulated lye (caustic soda) to 10 gallons of water. Bring the solution to a

[5] For mature squash see Pumpkin and Squash, p. 75.

boil and immerse the sweetpotatoes in it for 5 minutes, counting from the time the solution returns to a boil. When the lye solution becomes thickened from use, discard it and make a fresh supply. Remove sweetpotatoes from the lye solution and place them in a tank of cold, clear water. Stir the sweetpotatoes around with a wooden paddle until the skins are removed. Change the water and wash the sweetpotatoes thoroughly or turn a hose on them to remove all the lye solution. By hand, trim the sweetpotatoes for defective parts and grade them according to size. Hold the sweetpotatoes in cold water during the time required for trimming. As they are trimmed, drop them into a 2-percent salt solution to prevent discoloration.

When ready to pack, wash off the salt solution by dipping the sweetpotatoes into clear, cold water. Sweetpotatoes are then packed without further treatment. If it is not practical to lye-peel sweetpotatoes, they may be precooked in a retort at 240° F., for 6 to 10 minutes for small sweetpotatoes, 10 to 18 minutes for medium-sized ones, and up to 25 minutes for large ones. Care must be taken not to permit the sweetpotatoes to come in contact with the retort crate as this will discolor them. Use aluminum pans or galvanized-metal baskets or line the retort crate with wooden slats. Sweetpotatoes precooked for peeling may be permitted to cool slightly for ease in handling. They should be peeled and packed rapidly to prevent discoloration. Precooked sweetpotatoes will be soft, and care must be taken not to pack them too tightly into cans.

Filling.—Pack sweetpotatoes into cans to within one-fourth inch of the top. It is best to pack whole small sweetpotatoes separate from the sliced ones. Do not pack them too closely as this will prevent heat penetration and the process given will not be adequate. Add boiling lightweight sirup made according to instructions given in table 9, to fill the can completely. Do not use a heavier sirup as it will mask the natural flavor of the sweetpotatoes.

Exhausting.—Exhaust sweetpotatoes to 175° F.

Sealing.—Seal cans as soon as the exhaust temperature is reached. Do not permit cans to cool before processing.

Processing.—Process sweetpotatoes at 240° F., as follows:

Size of can:	*Minutes*
No. 2	45
No. 2½	50
No. 3	50

Cooling.—Immediately after processing is completed cool the cans as rapidly as possible in cold running water to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Sweetpotatoes, solid pack

Container.—Use plain cans.

Quality of produce.—Freshly dug sweetpotatoes are best for canning. However, stored sweetpotatoes that have been cured may be canned. In the latter case the sweetpotatoes may be somewhat softer owing to the higher sugar content of the cured product. Care should be taken not to bruise the sweetpotatoes as soft rot develops quickly. Sweetpotatoes harvested from vines that have been frosted should not be canned.

Preparation.—Soak the sweetpotatoes in cold water if necessary to remove clinging soil. Scrub with brush or wash them with a spray of water to remove all dirt. Sweetpotatoes may be precooked and peeled or lye-peeled and precooked for packing. Grade for size to make precooking more uniform, setting small sweetpotatoes aside for sirup pack.

Precooking for peeling.—To precook sweetpotatoes for peeling, place them in slatted boxes or in the retort crate in layers of not more than 6 inches deep. If the retort crates are used they should be lined with wooden slats to prevent the sweetpotatoes from coming in direct contact with the crate which will cause discoloration. The steam is turned into the retort slowly and the temperature brought up to 240° F. Gradual heating is desirable to avoid bursting the skins. Hold retort at this temperature for 6 to 10 minutes for small sweetpotatoes if they are to be used for solid pack, 10 to 18 minutes for medium-sized ones, and up to 25 minutes for large ones. Moist varieties will require less time for precooking. At the end of the heating period, open the retort promptly so that the steam may be evaporated rapidly. This will aid in getting a dry product in the can. The sweetpotatoes are then peeled as quickly as possible to conserve the heat. Canvas gloves will aid in handling the sweetpotatoes more rapidly.

Lye peeling and steaming.—For lye-peeling sweetpotatoes use a 10-percent solution made by adding 9¼ pounds of lye to 10 gallons of water. Bring solution to a boil and immerse sweetpotatoes in it for 5 minutes counting from the time the solution returns to a boil. When the lye solution becomes thickened from use, discard it and make a fresh supply. Remove the sweetpotatoes from the lye solution and place them in a tank of cold, clear water. Stir the sweetpotatoes around with a wooden paddle until the skins are removed. Change the water and wash them again thoroughly or turn hose on them to remove all the lye solution. By hand, trim the sweetpotatoes for defective parts and grade them according to size for uniform steaming. Hold them in cold water during the time required for trimming. As they are trimmed, drop them into a 2-percent salt solution to prevent discoloration. When they are ready to steam, wash off the salt solution by dipping them into clear cold water. Steam the sweetpotatoes in a retort at 240° F. Small sweetpotatoes should be held at this temperature

for 6 to 10 minutes, medium-sized ones for 10 to 18 minutes, and large ones up to 25 minutes.

Filling.—Pack sweetpotatoes as hot as possible to avoid discoloration and to shorten the time for exhausting. Mash them into cans to fill cans completely. Do not leave air spaces, as they cause discoloration.

Exhausting.—Sweetpotatoes should be exhausted to a center-can temperature 5° higher than the initial temperature at which processing begins in order to allow for cooling during sealing. (See statement on initial temperature, p. 56.)

Sealing.—Seal cans as soon as they are exhausted. Do not permit cans to cool before processing.

Processing.—The length of processing time depends on the initial temperature—the higher the initial temperature, the shorter the process needed. Process sweetpotatoes at 240° F., as follows:

Size of can:	Having an initial temperature of— 80° F.	120° F.	150° F.	180° F.
	Minutes	*Minutes*	*Minutes*	*Minutes*
No. 2	110	105	95	85
No. 2½	130	120	110	95
No. 3	135	125	115	100

Cooling.—Immediately after processing is completed cool the cans as rapidly as possible in cold running water to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. When the cans are removed from the cold water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

TABLE 12.—*Time and temperature for processing nonacid vegetables*

Produce	Type of can	Recommended center can closing temperature	Initial temperature	Time to process at 240° F. (10.3 lbs. pressure) at sea level[1] No. 2 cans	No. 2½ cans	No. 3 cans	No. 10 cans
		° *F.*	° *F.*	*Minutes*	*Minutes*	*Minutes*	*Minutes*
Asparagus, cuts	Plain	140	------	25	25	26	35
Asparagus, spears	do	140	------	25	25	------	------
Beans, green and wax	do	140	------	20	25	25	35
Beans, green lima	C-enamel or plain	140	------	35	40	40	55
Beets, sliced	R-enamel	160	------	30	30	30	45
Beets, whole, cubed, or quartered	do	160	------	30	30	30	40
Carrots, sliced	Plain	160	------	30	30	30	45
Carrots, whole, wedges, cubes	do	160	------	30	30	30	40
Corn, cream-style	C-enamel	185	180	90	------	------	------
Corn, whole-grain	do	185	------	50	------	------	------
Mixed vegetables	Plain	150	------	35	45	45	------
Okra	do	150	------	17	------	------	------
Peas, green	do	140	------	35	40	40	55
Pumpkin-squash	R-enamel	185	180	70	95	100	190
Pumpkin-squash	do	165	160	80	105	110	210
Summer squash	Plain	150	------	40	------	------	------
Sweetpotatoes, in sirup	do	175	------	45	50	50	------
Sweetpotatoes, solid pack	do	85	80	110	130	135	------
Sweetpotatoes, solid pack	do	125	120	105	120	125	------
Sweetpotatoes, solid pack	do	155	150	95	110	115	------
Sweetpotatoes, solid pack	do	185	180	85	95	100	------
				Time to process at 252° F. (16.2 lbs. pressure) at sea level[1]			
Greens	Plain	150	------	45	50	50	60

[1] The times given here for processing under pressure apply only to places at sea level. When produce is canned under pressure at altitudes higher than sea level, the pressure must be increased approximately ½ pound for each 1,000 feet. See table 8 for making altitude adjustment.

Canning meat

Many farm families can beef, chicken, and other home-produced meats to help spread supplies throughout the year. All meats for canning should be from healthy animals of good quality, slaughtered and handled in a strictly sanitary manner *(4)*, *(14)*, *(15)*. After the animal is slaughtered, the meat should be chilled as rapidly as possible and canned promptly. If necessary to hold for 2 or 3 days, keep at 40° F. or lower. Avoid freezing meat, if possible. If meat does freeze, keep it frozen until canning time as meat thawed after freezing is highly perishable. It is not necessary to age meat to be used for canning.

Community canning centers are ideal for getting the meat-canning job done in a minimum of time and according to safe methods as both space and suitable equipment are available.

Meats are nonacid products and must be processed at a sufficiently high temperature (240° F.) and held there long enough to make sure of killing the bacteria that cause dangerous spoilage. This can be accomplished only by processing meats under pressure in a retort or pressure canner. If meats are not properly

processed they may spoil or lead to serious food poisoning. Follow carefully the directions given in order to assure a safe, good-quality product.

Beef, veal, mutton, lamb, pork, and the meat of large game animals are canned by the same method. Chicken, duck, turkey, and other poultry, and small game animals, such as rabbit, are canned alike.

Mixtures, such as chili con carne, hash, and stews with vegetables, although successfully canned by commercial canners, are not recommended for community canning. It is safer to can each food separately and combine them when ready to serve.

Table 13 will be helpful in estimating the number of cans that will be needed for processing a given quantity of fresh meat.

TABLE 13.—*Approximate quantities of meat required to fill specified can sizes*

Product	Quantity required to fill a—		
	No. 2 can	No. 2½ can	No. 3 can
	Pounds	*Pounds*	*Pounds*
Beef, round (untrimmed)	1¾ to 2	2½ to 3	3 to 3½
Beef, rump (untrimmed)	3 to 3½	4¼ to 4¾	5 to 5½
Chicken (dressed, undrawn) to be canned with bone	2¾ to 3½	3¾ to 4¾	4½ to 5½
Chicken (dressed, undrawn) to be canned without bone	4¼ to 4¾	6 to 6¾	7 to 8
Pork loin (untrimmed)	3 to 3½	4¼ to 4¾	5 to 5½

Roasts, steaks, and stew meat

Container.—Use plain cans.

Boning and cutting.—Cut meat from the bone (*13*). Cut out the tendons and blood clots. Trim off most of the fat. Too much fat may cause spoilage as it retards heat penetration. The large, tender pieces are canned as roasts, steaks, or chops. The tougher cuts are canned as stew meat or ground meat. The bones are used to make broth to pour over the meat to fill the cans, or to make soup stock. Cut roasts to fit the can with the grain of the meat running lengthwise. Steaks and chops are cut as for serving fresh and packed in layers to fit the can. The smaller pieces of stew meat are handled and processed in the same manner as the larger pieces.

Precooking and packing.—Roasts, steaks, and stews may be precooked and packed hot or packed raw and exhausted in the can. Precooking or exhausting of meat before processing shrinks the meat sufficiently to assure a full pack, expels the air from the produce to get the proper vacuum in the can, and aids heat penetration so that produce is safe when processed for the period of time given.

If meat is to be packed hot, precook it as follows: Place pieces of meat loosely in a large shallow pan that will fit inside the retort. Add a small amount of water to keep the meat from sticking. The pan should be deep enough to retain the juices that will come from the meat during heating. Place hardwood sticks across the top of the pan to permit the stacking of three or four pans in the retort. Bring the retort up slowly to 240° F. For large pieces of meat hold at this temperature for 25 to 30 minutes or until the meat has a pink, rather than red, color at the center. Stew meat heated in retorts will require but 15 to 20 minutes at 240° F. Stew meat may also be heated in a steam-jacketed kettle. Add sufficient water to cover the meat partially and allow it to simmer from 25 to 40 minutes or until the pieces of meat are thoroughly heated through and are only slightly pink in the center. Stir occasionally so that the meat will heat evenly. Pack hot pieces into cans as closely as possible to within one-half inch of the tops. If salt is desired put it into the clean cans before packing the meat. Use level measurements of running salt or salt tablets, as follows:

Size of can:	Quantity of salt	
	Running salt	Salt tablet
	Teaspoonful	*Grains*
No. 2	½	50–75
No. 2½	¾	75–90
No. 3	1	90–100

Fill the cans completely with boiling broth which has been skimmed of fat. Exhaust if necessary to a center-can temperature of 170° F. The cans should be sealed, washed, and processed immediately.

If meat is to be packed raw, fit the pieces closely into cans to fill them completely. If salt is desired, put it into the clean cans before packing the meat. Use the same quantities of salt as those given for meat that has been precooked and packed hot. Place the cans of raw meat in the exhaust box and heat to a center-can temperature of 170° F. This will require about 50 minutes. When the center-can temperature has been reached, press the meat down into the cans to one-half inch below the top. The liquid from the meat may be sufficient to completely fill the cans. If additional liquid is needed, add boiling broth which has been made from the bones and skimmed of fat, or add boiling water. The cans should be sealed, washed, and processed immediately.

Sealing.—Before sealing the cans care should be taken to remove all meat particles from the edge of the can as they may prevent a perfect seal.

Washing.—Dip cans into a tank of boiling water to remove grease and place at once in the retort for processing. Do not permit cans to cool before processing.

Processing.—Process roasts, steaks, and stew meat at 240° F., as follows:

Size of can:	*Minutes*
No. 2	65
No. 2½	90
No. 3	90

Cooling.—Immediately after processing is completed cool the cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. Meats canned in No. 3 cans or smaller ones can be cooled successfully in cold, running water. However, if buckling occurs in No. 3 cans

it may be necessary to cool them under pressure. (See instructions for pressure cooling of cans, p. 18.) When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Ground meat

Container.—Use plain cans.

Preparation.—Small pieces of meat from the less-tender cuts may be ground. Only fresh, clean meat, trimmed of most of its fat should be used. Too much fat will retard heat penetration and may result in spoilage. Keep meat cold and handle as rapidly as possible. Never use meat of doubtful freshness as it may spoil the whole batch. If desired, add 1 level teaspoonful of salt to 1 pound of ground meat. Mix it well through the meat before grinding. When making pork sausage, any tested recipe may be used, but do not add sage as it is likely to give the canned sausage a bitter flavor. Use other spices sparingly because flavors change with processing and storing. Grind the meat, using the one-fourth- or three-eighth-inch plate of the meat grinder. Mix again to assure an even distribution of salt and fat. Ground raw meat may be packed solid in cans or made into cakes or links and precooked before filling into the cans.

Solid pack.—Pack raw ground meat solidly into cans and level with the top. Place in the exhaust box and heat to a center-can temperature of 170° F. This will require about 75 minutes. When the center-can temperature has been reached press the meat down into cans, about one-half inch below the top. The liquid from the meat should be sufficient to completely fill the can. If more liquid is needed, add boiling broth which has been made from the bones and has been skimmed of fat, or add boiling water to fill the cans to the top. Seal promptly, wash cans, and process immediately.

Cakes or links.—Ground meats made into cakes or links are packed in broth or water. This method of packing aids heat penetration and makes the time of processing shorter. Pork sausage is usually packed in this manner. Make cakes thin and uniform and of a size to fit the can. Fill sausage casings and tie in links to fit the length of the can, allowing about ½-inch head space. Precook cakes or links in a pan over a hot plate or in the bottom of a steam-jacketed kettle until medium done or until the red color at the center is almost gone. Turn cakes or links so they will heat evenly and be slightly browned. Do not let them burn or become too brown or crusty as this will impair their flavor. Pack cakes into cans in layers to within one-half inch of the top. Pack links on end. Do not pack them too closely. Skim fat from drippings and set aside. Do not use fat in canning. Add water to the drippings and bring to a boil. Allow ¾ to 1 cup of liquid for a No. 2 can. Pour boiling broth over cakes or links to fill the can or fill with boiling water. Run knife down inside the can and adjust the cakes or links slightly. This will aid in distributing liquid. Add more liquid if necessary to fill the can to the top. Exhaust if necessary to a center-can temperature of 170° F. Seal cans promptly, wash, and process immediately.

Sealing.—Before sealing the cans, care should be taken to remove all meat particles from the edge of the can as they may prevent a perfect seal.

Washing.—Dip cans into a tank of boiling water to remove grease and place in the retort for processing. Do not permit cans to cool before processing.

Processing.—The processing time for ground meat, solid pack, is necessarily longer than for cakes or links packed in liquid since the solid pack tends to slow down heat penetration. Links should be processed in a vertical position. Process ground meat at 240° F., as follows:

	Solid pack	Cakes or links
Size of can:	*Minutes*	*Minutes*
No. 2	100	65
No. 2½	135	90
No. 3	135	90

Cooling.—Immediately after processing is completed cool the cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. Meats canned in No. 3 cans or smaller can be cooled successfully in cold running water. However, if buckling occurs in No. 3 cans it may be necessary to cool them under pressure. (See instructions for pressure cooling of cans, p. 18.) When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then should be stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Heart and tongue

Container.—Use plain cans.

Preparation.—Heart and tongue are packed hot for canning. To prepare heart wash thoroughly. Remove thick connective tissue and cut into pieces. Place in a steam-jacketed kettle and partially cover the meat with water. Simmer for 25 to 40 minutes or until the pieces of meat are thoroughly heated and are only slightly pink in the center. To prepare tongue, wash it thoroughly, place in steam-jacketed kettle and cover with boiling water. Simmer about 45 minutes, or until skin can be removed, before cutting into pieces.

Filling.—If salt is desired, add it to the clean can before packing the meat. Either salt tablets or running salt may be used, as follows:

	Quantity of salt	
	Running salt	Salt tablet
Size of can:	*Teaspoonful*	*Grains*
No. 2	½	50 to 75
No. 2½	¾	75 to 90
No. 3	1	90 to 100

Pack heart and tongue separately. Fill hot meat into cans to within ½ inch of top. Completely fill the cans with boiling broth from the heart or tongue.

Exhausting.—Exhaust if necessary to a center-can temperature of 170° F.

Sealing.—Seal cans immediately after removal from the exhaust box, being careful not to leave any meat particles on the rim of the can. Place at once in retort for processing. Do not permit cans to cool before processing.

Processing.—Process heart and tongue at 240° F., as follows:

Size of can:	*Minutes*
No. 2	65
No. 2½	90
No. 3	90

Cooling.—Immediately after processing is completed cool the cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. Meats canned in No. 3 cans, or smaller, can be cooled successfully in cold running water. However, if buckling occurs in No. 3 cans it may be necessary to cool them under pressure. (See instructions for pressure cooling of cans, p. 18.) When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Corned beef

Container.—Use plain cans.

Preparation.—Wash the corned beef and cut into pieces suitable for packing. Remove excess fat for it will retard heat penetration and may result in spoilage. Cut large pieces to fit the can with the grain of the meat running lengthwise. Place the meat in a steam-jacketed kettle and cover with cold water. Bring to a boil. If broth tastes very salty, drain and cover the meat with fresh water and parboil again.

Filling.—Pack hot meat into cans to within one-half inch of tops. Cover with boiling water to fill the can completely.

Exhausting.—Exhaust if necessary to a center-can temperature of 170° F.

Sealing.—Seal cans immediately, being careful to remove any meat particles that may be on edge of the can.

Washing.—Dip cans into tank of boiling water to remove grease and place at once in retort for processing. Do not permit cans to cool before processing.

Processing.—Process corned beef at 240° F., as follows:

Size of can:	*Minutes*
No. 2	65
No. 2½	90
No. 3	90

Cooling.—Immediately after processing is completed cool the cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and prevent rusting. Meats canned in No. 3 cans, or smaller, can be cooled successfully in cold running water. However, if buckling occurs in No. 3 cans it may be necessary to cool them under pressure. (See instructions for pressure cooling of cans, p. 18.) When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then should be stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Chicken

All chickens for canning should be of the best quality and should be killed and dressed in a strictly sanitary manner. Instructions for killing and dressing poultry are given in Farmers' Bulletin 1377, Marketing Poultry (*9*). After killing and dressing, chickens should be chilled as rapidly as possible and canned promptly. It is recommended that killing and dressing of poultry be done at the canning center. If this cannot be arranged, patrons should be advised regarding proper methods for doing the job at home or heavy losses from spoilage may occur. For best-flavored canned chicken, select plump stewing hens. Young birds are not so suitable for canning as they often lack flavor and, since they require the same processing time as older birds, they may cook to pieces.

Container.—Use plain cans.

Preparation.—Dry the chilled birds, singe, and wash. Remove oil gland, head, and feet. Disjoint the bird and remove entrails. For information on cutting up chicken for canning see AWI–110, Home Canning of Meat (*11*). Special care should be taken not to break the gall bladder or the meat will be bitter. Clean and wash gizzard and remove gall bladder from liver. Do not precook or can giblets with the meaty portions of chicken as they will impart an off-flavor to the rest of the meat. Livers should be canned separately. Gizzards and hearts may be canned together. Chicken may be packed with or without bone. In either instance it may be precooked before packing or packed raw and exhausted. Precooking or exhausting of chicken before processing shrinks the meat sufficiently to assure a full pack, expels the air from the product to get the proper vacuum in the can, and aids heat penetration so that the product is safe when processed for the time given.

Chicken with bone.—To pack chicken with bone, saw drumsticks off short, bone the breast, but leave bone in other meaty pieces, such as second joints. Trim off large lumps of fat. Set aside bony pieces, such as the backs and wings, for making soup stock. If chicken is to be precooked and packed hot, place the meaty portions in a steam-jacketed kettle and cover with hot water. Precook until the meat is medium done and when cut shows almost no pink color at the center of the pieces. Stir occasionally so that the meat will heat evenly. Pack the hot chicken into cans, placing the second joints and drumsticks so that the skin is next to the can. Fit the breast pieces into the center. Add smaller pieces to fill the can to within one-half inch of the top. If salt is desired add it to the clean can before packing the chicken. Use level

measurements of running salt, or salt tablets, as follows:

	Quantity of salt	
	Running salt	Salt tablet
Size of can:	*Teaspoonful*	*Grains*
No. 2	½	50–75
No. 2½	¾	75–90
No. 3	1	90–100

Fill the cans completely with boiling broth which has been skimmed of fat. Exhaust if necessary to a center-can temperature of 170° F. Seal promptly, wash cans, and process immediately.

To raw-pack chicken with bones follow these same instructions with the following exceptions:

(1) Pack raw chicken into cans to fill them completely.

(2) Exhaust to a center-can temperature of 170° F. (This will take about 50 minutes.)

(3) When the center-can temperature has been reached, press the chicken down into the cans to within ½ inch of the top. The liquid from the chicken should completely fill the can. If additional liquid is needed add boiling broth which has been made from the bony pieces and skimmed of fat, or add boiling water. The cans should then be sealed, washed, and processed immediately.

Chicken without bone.—Chicken canned without bone is usually precooked to aid in removing the meat from the bone. Place the meaty pieces of chicken in a steam-jacketed kettle and cover with hot water. Precook until the meat is medium done and a cut shows almost no pink color at the center of the pieces. After precooking, cut the meat off the bone but do not remove the skin. Pack the hot, boned chicken into cans to within one-half inch of the tops. If salt is desired, add it to the clean can before packing the chicken, using the same quantity as for chicken with bone. Fill the cans completely with boiling broth. Exhaust if necessary to a center-can temperature of 170° F. Seal promptly, wash cans, and process immediately.

To pack raw chicken without bone prepare it as follows: Remove the bone from the drumsticks, thighs, and breast. Do not remove the skin. Set aside bones and bony pieces for soup stock. Pack the raw, boned pieces into cans to fill them completely. If salt is desired add it to the clean can before packing the chicken. Use the same quantity as for chicken with bone. Place cans in the exhaust box and heat to a center-can temperature of 170° F. Press chicken down into can to within ½ inch of top. The liquid from the chicken should completely fill the can. If additional liquid is needed add boiling broth which has been skimmed of fat, or add boiling water. Seal, wash, and process cans immediately.

Sealing.—Before sealing cans, care should be taken to remove all meat particles from the edge of the can as they may prevent a perfect seal.

Washing.—Dip cans in a tank of boiling water to remove grease and place in the retort for processing. Do not permit cans to cool before processing.

Processing.—Chicken without bone must be processed longer than chicken with bone. Process chicken at 240° F., as follows:

	With-bone	Without bone
Size of can:	*Minutes*	*Minutes*
No. 2	55	65
No. 2½	75	90
No. 3	75	90

Cooling.—Immediately after processing is completed cool the cans as rapidly as possible to 100° F. This leaves enough heat in the cans to dry them and prevent rusting. Meats canned in No. 3 cans, or smaller, can be cooled successfully in cold running water. However, if buckling occurs in No. 3 cans it may be necessary to cool them under pressure. (See instructions for pressure cooling of cans, p. 18.) When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Chicken giblets

Container.—Use plain cans.

Preparation.—Giblets should be kept cold until ready to can. Because of the flavor, it is best to can livers alone. Gizzards and hearts may be canned together. Giblets are precooked in a steam-jacketed kettle or in a small kettle over a hot plate. Cover them with broth made from the bony pieces or cover with hot water. Cook the giblets until medium done or until they have lost their raw appearance when cut into.

Filling.—Pack giblets hot into No. 2 cans to within one-half inch of the tops. Add salt if desired before adding broth. Free running salt or salt tablets may be used, as follows:

	Quantity of salt	
	Running salt	Salt tablet
Size of can:	*Teaspoonful*	*Grains*
No. 2	½	50–75
No. 2½	¾	75–90
No. 3	1	90–100

Pour boiling broth over giblets to fill the can to the top.

Exhausting.—Exhaust if necessary to a center-can temperature of 170° F.

Sealing.—Seal cans immediately, being careful to remove any meat particles that may be on the edge of the can. Place cans in retort and process at once.

Processing.—Process No. 2 cans of giblets at 240° F. for 65 minutes.

Cooling.—Immediately after processing is completed, cool the cans as rapidly as possible in cold running water to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked

in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

Soup stock

Container.—Use plain cans.

Preparation.—Place bony pieces of chicken or other meat in steam-jacketed kettle and partially cover with water. Add a small amount of salt for flavor. Simmer until meat is tender. Remove bones from broth and cut off pieces of meat. Skim fat off the broth and continue cooking to concentrate it. Before filling broth into cans add pieces of meat which were removed from the bone and bring to a boil.

Filling.—Stir broth as each can is filled so that meat and sediment will be evenly distributed. Fill cans full.

Exhausting.—It will not be necessary to exhaust soup stock filled into cans at boiling temperature. Do not let the temperature drop below 170° F. before sealing.

Sealing.—Seal cans immediately and place in retort. Do not let cans cool before processing.

Processing.—Process soup stock at 240° F., as follows:

Size of can:	*Minutes*
No. 2	20
No. 2½	25
No. 3	25

Cooling.—Immediately after processing is completed, cool the cans as rapidly as possible in cold running water to 100° F. This leaves enough heat in the cans to dry them and to prevent rusting. When the cans are removed from the cooling water they should be tilted, to drain off excess water, and then stacked in a well-ventilated place until cold. Do not put cans into cartons until cold and dry.

TABLE 14.—*Time and temperature for processing meats*

Meats	Type of can	Recommended center can closing temperature	Time to process at 240° F. (10.3 pounds pressure) at sea level [1]		
			Size of can		
			No. 2	No. 2½	No. 3
		° F.	*Minutes*	*Minutes*	*Minutes*
Chicken with bone	Plain	170	55	75	75
Chicken without bone	do	170	65	90	90
Chicken giblets	do	170	65	----	----
Corned beef	do	170	65	90	90
Ground meat (cakes and links).	do	170	65	90	90
Ground meat (solid pack).	do	170	100	135	135
Heart and tongue	do	170	65	90	90
Roast, steak, and stew meat.	do	170	65	90	90
Soup stock	do	170	20	25	25

[1] When products are canned under pressure at altitudes higher than sea level the pressure must be increased approximately ½ pound for each 1,000 feet. See table 8 for making altitude adjustment

Partial list of manufacturers of canning equipment and supplies

Batch-type exhaust boxes:
- J. P. Dowell Co., McKinney, Tex.
- Dixie Canner Co., P. O. 1348, Athens, Ga.

Blanching baskets, pails, and pans:
- Chisholm-Ryder Co., Inc., 4121 Highland Avenue, Niagara Falls, N. Y.
- Food Machinery Corporation, 101 East Maple Street, Hoopeston, Ill.
- F. H. Langsenkamp Corporation, Harmon and South Streets, Indianapolis 4, Ind.
- A. K. Robins & Co., Inc., 111 Concord Street, Baltimore, Md.

Boilers:
- Orr & Sembower, Inc., Reading, Pa.
- Hamburg Boiler Works, Inc., Hamburg, Pa.
- Birchfield Boiler, Inc., Tacoma 1, Wash.
- Gar Wood Industries, Inc., 7924 Riopelle Street, Detroit 11, Mich.
- Milwaukee Boiler Manufacturing Co., 1101 South Forty-first Street, Milwaukee, Wis.
- Lookout Boiler & Manufacturing Co., Road and Compress Streets, Chattanooga, Tenn.
- Eclipse Fuel Engineering Co., 705 South Main Street, Rockford, Ill.
- Athens Boiler & Machine Works, Inc., Thomas and Hoyt Streets, Athens, Ga.
- J. J. Finnigan Co., Inc., 455 Means Street, Atlanta, Ga.
- Kewanee Boiler Corporation, Kewanee, Ill.
- Farrar & Trefts, Inc., 20 Milburn Avenue, Buffalo 12, N. Y.

Brush pens:
- Charles G. Stott Co., Inc., 1310 New York Avenue NW., Washington 5, D. C.
- Floquil Products, Inc., 1976 Broadway, New York 23, N. Y.

Butchers' supplies and equipment:
- Bromann Bros., 857 Fulton Street, Chicago 7, Ill.
- The Cincinnati Butchers' Supply Co., Helen and Blade Streets, Cincinnati, Ohio.
- The C. Schmidt Co., John and Livingston Streets, Cincinnati, Ohio.

Can marking inks:
- Charles G. Stott Co., Inc., 1310 New York Avenue NW., Washington 5, D. C.
- Floquil Products, Inc., 1976 Broadway, New York 23, N. Y.
- Kienle & Co., 33 Nassau Avenue, Brooklyn, N. Y.
- California Ink Co., Inc., 545 Sansome, San Francisco, Calif.
- The Superior Type Co., 1810 West Larchmont Avenue, Chicago 13, Ill.

Can sealers:
- Max Ams Machine Co., Scofield Avenue, Bridgeport, Conn.
- Burpee Can Sealer Co., 128 West Liberty Street, Barrington, Ill.
- Dixie Canner Co., P. O. 1348, Athens, Ga.
- National Pressure Cooker Co., Eau Claire, Wis.
- Wisconsin Aluminum Foundry Co., Inc., Sixteenth Street at Franklin, Manitowoc, Wis.

Canning thermometers:
- Manning, Maxwell & Moore, Inc., 11 Elias Street, Bridgeport 2, Conn.
- C. J. Tagliabue Manufacturing Co., Park Avenue and Rucks Street, Brooklyn 5, N. Y.
- The Palmer Co., 2501 Norwood Avenue, Cincinnati, Ohio.
- Moeller Instrument Co., One Hundred and Thirty-second Street and Eighty-ninth Avenue, Richmond Hill 18, N. Y.
- Taylor Instrument Co., Rochester 1, N. Y.

Chain hoists:
- Food Machinery Corporation, 101 East Maple Street, Hoopeston, Ill.
- A. K. Robins & Co., Inc., 111 Concord Street, Baltimore, Md.
- Chisholm-Ryder Co., Inc., 4121 Highland Avenue, Niagara Falls, N. Y.
- Berlin Chapman Co., Berlin, Wis.

Combination pressure canner, cooker, and stockpot (18 No. 3 cans):
- Legion Utensils Corporation, Fortieth Avenue and Twenty-first Street, Long Island City, N. Y.

Cooking coils:
- Berlin Chapman Co., Berlin, Wis.
- Chisholm-Ryder Co., Inc., 4121 Highland Avenue, Niagara Falls, N. Y.
- Food Machinery Corporation, 101 East Maple Street, Hoopeston, Ill.
- Hamilton Copper & Brass Works, Dixie Highway and Lincoln Avenue, Hamilton, Ohio.
- F. H. Langsenkamp Corporation, Harmon and South Streets, Indianapolis 4, Ind.
- A. K. Robins & Co., Inc., 111 Concord Street, Baltimore, Md.

Dead weight gage testers:
- The Ashton Valve Co., 161–171 First Street, Cambridge, Mass.
- Crosby Steam Gage & Valve Co., 165 Broadway, New York 6, N. Y.
- Star Brass Manufacturing Co., 104–114 East Dedham Street, Boston, Mass.
- Ashcroft Gauge Division, Manning, Maxwell & Moore, Inc., Kossuth Street, Bridgeport 2, Conn.

Factory trucks:
- Berlin Chapman Co., Berlin, Wis.
- Chisholm-Ryder Co., Inc., 4121 Highland Avenue, Niagara Falls, N. Y.
- Food Machinery Corporation, 101 East Maple Street, Hoopeston, Ill.
- A. K. Robins & Co., Inc., 111 Concord Street, Baltimore, Md.

Food choppers and grinders; food presses:
- Enterprise Manufacturing Co., Third and Dauphin Streets, Philadelphia, Pa.
- Hobart Manufacturing Co., Troy, Ohio.
- The Cincinnati Butchers' Supply Co., Helen and Blade Streets, Cincinnati, Ohio.

Gas Burners:
- Charles A. Hones, Inc., Baldwin, N. Y.
- Eclipse Fuel Engineering Co., 705 South Main Street, Rockford, Ill.
- Standard Gas Equipment Corporation, Bayard and Hamburg Streets, Baltimore, Md.
- Surface Combustion Division, Grover and Sherman Streets, Toledo, Ohio.

General canning equipment:
- Anderson-Barngrover Division, Food Machinery Corporation, San Jose, Calif.
- Ayars Machine Co., North Salem, N. J.
- Berlin Chapman Co., Berlin, Wis.
- F. H. Langsenkamp Corporation, Harmon and South Streets, Indianapolis 4, Ind.
- A. K. Robins & Co., Inc., 111 Concord Street, Baltimore, Md.
- Food Machinery Corporation, 101 East Maple Street, Hoopeston, Ill.
- Cox Foundry & Machine Co., 985 Cox Avenue SW., Atlanta, Ga.
- Chisholm-Ryder Co., Inc., 4121 Highland Avenue, Niagara Falls, N. Y.
- Dixie Canner Co., P. O. 1348, Athens, Ga.

Gloves:
- Dunn Products, 333 South Wood Street, Chicago 12, Ill.
- Hood Rubber Co., Inc., Watertown, Mass.
- Latex Glove Manufacturing Co., 813 North Wells Street, Chicago 10, Ill.
- Miller Rubber Co., High and Cole Streets, Akron, Ohio.
- The Wilson Rubber Co., 1248 Garfield Avenue, SW., Canton 6, Ohio.

Inspector's test gage:
- The Ashton Valve Co., 161–171 First Street, Cambridge, Mass.
- Crosby Steam Gage & Valve Co., 165 Broadway, New York 6, N. Y.

Inspector's test gage—Continued
- Star Brass Manufacturing Co., 104–114 East Dedham Street, Boston, Mass.
- Ashcroft Gauge Division, Manning, Maxwell & Moore, Inc., Kossuth Street, Bridgeport 2, Conn.

Open-process tanks:
- Berlin Chapman Co., Berlin, Wis.
- Chisholm-Ryder Co., Inc., 4121 Highland Avenue, Niagara Falls, N. Y.
- Food Machinery Corporation, 101 East Maple Street, Hoopeston, Ill.
- Hamilton Copper & Brass Works, Dixie Highway and Lincoln Avenue, Hamilton, Ohio.
- F. H. Langsenkamp Corporation, Harmon and South Streets, Indianapolis 4, Ind.
- A. K. Robins & Co., Inc., 111 Concord Street, Baltimore, Md.

Pressure canners (7 and 14 quart):
- Burpee Can Sealer Co., 128 West Liberty Street, Barrington, Ill.
- National Aluminum Manufacturing Co., Peoria, Ill.
- Wisconsin Aluminum Foundry Co., Sixteenth Street at Franklin, Manitowoc, Wis.
- The National Pressure Cooker Co., Eau Claire, Wis.
- Lakeside Aluminum Co., 2633 SE. Fourth Street, Minneapolis, Minn.
- The Pressure Cooker Co., 338 Broadway, Denver, Colo.

Pressure gages:
- The Ashton Valve Co., 161–171 First Street, Cambridge, Mass.
- Crosby Steam Gage & Valve Co., 165 Broadway, New York 6, N. Y.
- Star Brass Manufacturing Co., 104–114 East Dedham Street, Boston, Mass.
- Ashcroft Gauge Division, Manning, Maxwell & Moore, Inc., Kossuth Street, Bridgeport 2, Conn.

Pressure reducing valves:
- Mason-Neilan Regulator Co., Pierce Square, Dorchester Station, Boston 24, Mass.
- Stickle Steam Specialties Co., 2215 Valley Avenue at Tacoma, Indianapolis 1, Ind.
- Fisher Governor Co., 1700 Fisher Building, Marshalltown, Iowa.

Pressure retorts:
- Dixie Canner Co., P. O. 1348, Athens, Ga.
- J. P. Dowell Co., McKinney, Tex.
- A. K. Robins & Co., Inc., 111 Concord Street, Baltimore, Md.
- Food Machinery Corporation, 101 East Maple Street, Hoopeston, Ill.
- Berlin Chapman Co., Berlin, Wis.
- Black, Sivalls & Bryson, Inc., 2131 Westwood Boulevard, Oklahoma City, Okla.

Retort thermometers:
- Manning, Maxwell & Moore, Inc., 11 Elias Street, Bridgeport 2, Conn.
- C. J. Tagliabue Manufacturing Co., Park Avenue and Rucks Street, Brooklyn 5, N. Y.
- The Palmer Co., 2501 Norwood Avenue, Cincinnati, Ohio.
- Moeller Instrument Co., One hundred and thirty-second Street and Eighty-ninth Avenue, Richmond Hill 18, N. Y.
- Taylor Instrument Co., Rochester 1, N. Y.

Salt tablets:
- Morton Salt Co., 310 South Michigan Avenue, Chicago, Ill.
- Diamond Crystal Salt Co., St. Clair, Mich.
- Scientific Tablet Co., 1522 North Hadley Street, St. Louis, Mo.

Steam-jacketed kettles:
- Lee Metal Products Co., Inc., 368 West Pine Street, Philipsburg, Pa.
- Mangrum, Holbrook & Elkus, 301 Golden Gate Avenue, San Francisco 2, Calif.
- Bucyrus Kettle Works, Inc., 741 East Warren Street, Bucyrus, Ohio.
- Aluminum Cooking Utensil Co., Fifth Avenue and Eleventh Street, New Kensington, Pa.

Steam-jacketed kettles—Continued
- Legion Utensils Corporation, Fortieth Avenue and Twenty-first Street, Long Island City, N. Y.

Tin cans:
- American Can Co., New York Central Building, 230 Park Avenue, New York 17, N. Y.
- Atlas Can Corporation, 241 Wythe Avenue, Brooklyn, N. Y.
- Continental Can Co., Inc., 100 East Forty-second Street, New York 17, N. Y.
- Eagle Can Co., 356 Mystic Avenue, Somerville, Mass.
- Independent Can Co., 1301–1331 South Howard Street, Baltimore, Md.
- Heekin Can Co., 435 New Street, Cincinnati, Ohio.
- Pacific Can Co., 290 Division Street, San Francisco, Calif.
- Phillips Can Co., Cambridge, Md.
- Western Can Co., Seventeenth and Rhode Island Streets, San Francisco, Calif.
- National Can Corporation, 110 East Forty-second Street, New York 17, N. Y.
- Crown Can Co., Erie Avenue at H, Philadelphia 34, Pa.

Water feed systems:
- The Ohio Injector Co., 100 Ejector Street, Wadsworth, Ohio.
- Penberthy Injector Co., 1242 Holden Avenue, Detroit 2, Mich.
- William Sellers & Co., Inc., 1600 Hamilton Street, Philadelphia, Pa.
- American Injector Co., 1481–1491 Fourteenth Avenue, Trix Station, Detroit, Mich.
- Hancock Valve Division, Manning, Maxwell & Moore, Inc., Kossuth Street, Bridgeport 2, Conn.

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